to Civil Engineering and Contracting

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Engineering News-Record

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Coming: Special Railroad Issue, March 6

Street Railway Under Reconstruction at Milwaukee, Wis.

No other roof can be *Worth* as much

IF BUILDERS would pause to make a careful cost comparison they would find, as hundreds have found, that the architectural beauty of Federal Roof Tile is a luxury that costs nothing—that on the contrary it is the mark of inherent permanence without maintenance expense, uniformity of manufacture and correct design — qualities that make Federal Cement Tile the most economical of all roofs.

The comparisons made here are not visionary; they are supported by volumes of data in the files of the Federal Engineering Department—data that will convince you that no other roof, at any initial cost high or low, can be *worth* as much as Federal Cement Tile.

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Federal Cement Tile is made in sizes and styles for all flat and pitched surfaces—red and natural finish.

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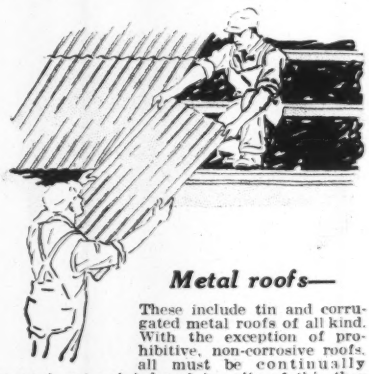
The composition covered wood roof—

This includes tar or asphalt and composition coverings. None of these roofs is fireproof—all require periodic recovering, painting and frequent repairs—all are short lived and greatly increase insurance rates. Half of all fires start or spread on the wood roof—and fire insurance does not cover interrupted production.



Metal roofs—

These include tin and corrugated metal roofs of all kind. With the exception of prohibitive, non-corrosive roofs, all must be continually scraped and painted and in spite of this they almost invariably rust out in the joints and from underneath. Moreover, temperature changes open joints, cause rust, and excessive repairs.

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These are either poured on the job or precast of fireproof material. It is an established fact that no material can rival the permanence of concrete, and concrete to be absolutely uniform must be precast under ideal conditions. There is nothing to burn about a Federal roof of precast concrete. It never requires covering when installed on pitched surfaces. Its life is measured in centuries. There are no repairs. It reduces insurance rates. Manufactured in the largest plant in the world, devoted exclusively to fireproof roofing, it stands on its record as the unrivalled roof.

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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High Finance

THE fantastic financing of the Ford offer for Muscle Shoals has been commented on before in these columns. That it has been taken seriously by so many people, politicians and otherwise, is testimony to the magic of the Detroiter's name, or to the average low mentality of a large number of our fellow citizens. But the prize for special pleading is taken by the majority of the committee of the House, which reported the Ford bill favorably. First, in order to show the monetary superiority of the Ford offer this committee amortizes the power company offer over 50 years and the Ford offer over 100 years, divides the first amortization by 50 and the second by 100 and offers the two hundred odd thousand per year Ford superiority as conclusive evidence of its more favorable return to the government. But, not content with this calm disregard of the mathematical increase of an amortized fund, the committee has the effrontery to include in the Ford amortization a total of $20,000,000, which is the *accumulated interest and capital at the end of 100 years of the $5,000,000 cash* Ford will pay for the eighty-million dollar plant which, the army reports, has a salvage value alone of close to ten million.

The Rudolph Hering Medal

IN FITTING recognition of a man and engineer who had a part either direct or indirect in training scores of American sanitary engineers, and who was for decades the friend and a source of inspiration of sanitarians throughout the world, a man who at the time of his death last year was generally recognized as the dean of sanitary engineers, there has been added a seventh to the prizes subject to annual award by the American Society of Civil Engineers. Known as the Rudolph Hering Medal, this prize will be awarded to the best sanitary engineering paper of the year, by a member of the society, printed in the *Transactions*. The subscriptions, which thus far have been gathered chiefly from members of the Sanitary Engineering Division of the Society, are enough to pay for the medal, once a die is provided, but more money is needed to cover the expense of a design for the medal and for the die itself.

Highway Accident Statistics

ANY action to develop a more keen interest in highway traffic accidents is welcome and the purpose of the National Automobile Chamber of Commerce to collect statistics deserves commendation. So much cannot be said of the plan of the Chamber to have these statistics collected through the agency of the newspapers. The results are bound to be haphazard and lacking in authority. There is in every state a highway department and in some there are special motor-vehicle bureaus, all more intensely concerned in the occurrence and nature of vehicle accidents on highways than any newspaper editor is likely to be and all more capable of interpreting causes and results than are "the bright young men of the press" provided with whatever "report forms" they may be. Accidents are one element of the highway traffic problem and their determination comes into the broad task of traffic survey and control which should be a state highway department function. If the automobile interests desire to advance accident study let them through their associations promote the legislation required to empower and finance state highway departments to count, analyze and report vehicle accidents on highways. Except the information is had from some such authoritative and responsible source it cannot command the respect that will bring the regulatory laws which are needed to govern motor vehicle operation. Mr. Graham's committee should revise its plan.

The Leaven Is Working

SLOWLY people are beginning to realize that the traffic problem in our cities is too big for policemen and chambers of commerce or merchant's associations. The engineer is being recognized as the only proper agent of reform. As yet the recognition is halting and in but few instances has it gone so far as the actual commission to go to work but the leaven is working and the rest will come in time. A recent editorial in the New York *Tribune* shows how the layman is beginning to think. "To provide New York City with permanent and adequate avenues of traffic" says the editor "is a greater engineering undertaking than the Panama Canal or the Catskill Aqueduct. Only a commission composed of experienced engineers and progressive and intelligent business men can deal with the problem either in the present or in the future. Both from the point of view of engineering and of finance the task on hand is of unprecedented magnitude. It must be approached scientifically." This is intelligent and far-seeing comment.

Construction Safety Codes

CONTRACTORS generally have been tardy in finding a place in the organized work of developing safety in construction. This inattention is reflected in the enactment of safety codes not particularly considerate of the contractor and in putting the execution of the new laws in the hands of labor unionists who are not too friendly to the contractor. Only last year and late in the year, was safety practice made a separate committee task by the Associated General Contractors. Fortunately an energetic committee chairman made up for this belated activity by presenting a report as logical and farseeing as any of the dozen considered at the annual convention in Chicago. Outstanding in the report was an admonition to contractors in association to take a forceful hand in safety practices. This advice may well be emphasized. Safety-code legis-

lation has made a start which labor unions and insurance interests are certain to endeavor to accelerate to a steady movement. None of the powers moving in this legislation will exert itself greatly to watch out for the contractor's interests which he is too shiftless himself to guard. There is good work being done through the American Engineering Standards Committee and the National Safety Council in formulating a construction safety code which shall be broad enough to guard all interests and promote no partisan interests. It would seem well for contractors through their national and local associations to put themselves squarely behind the code work which has been so well inaugurated.

The Continuous Highway

IN AN unobtrusive way a significant principle was stated in one of the sessions of the American Road Builders' Association meeting at Chicago last month. "The bridge is an integral part of the highway," said E. F. Kelley, of the Bureau of Public Roads, in discussing a number of highway bridge problems. Simple as this statement is, it has hitherto found only very limited application in practice. Its neglect is responsible for many of the troubles to which highway bridges give rise.

Railway bridge engineers have long quoted a corresponding principle, namely, that the bridge is an integral part of the railway roadbed; it should offer the same service and safety to traffic as a piece of track on normal earth support. The truth of this principle is generally recognized, though its practical influence has been rather less extensive; for example, while the principle might be served by carrying the ballasted roadbed across the bridge, financial difficulties have stood in the way of making this construction general practice. It happens that railway conditions are excellent even without full application of the principle. This is due to continuous maintenance work, to careful traffic regulation, and to expert and rigidly supervised operation. The highway does not have the advantage of these favoring conditions, and in consequence the matter of the continuous traffic surface comes to be of decisive importance.

Among the elements of bridge construction that refer back to this principle are width, curvature, grade relation to the adjacent portions of the highway, smoothness of surface, solidity. The bridge must make the meeting and passing of vehicles as easy as any other part of the road. It must provide equal safety against the chance of a vehicle running off the road. Above all, it should not be subject to damage or destruction itself in case some kind of accident due to traffic does occur.

Such matters as these, in fact, express and define the serviceability of the bridge. They contain the essential difficulties and fighting points of highway bridge engineering, whereas the construction of the steel or concrete supporting parts has been brought to a fairly satisfactory condition and is free from urgent problems. The course of development of highway bridge engineering in the next half dozen years is likely to depend largely on how energetically and successfully these other difficulties are attacked.

It is interesting to observe that the very first point in the application of the continuity principle is also one of the most troublesome, namely, that there should be no break in the traffic surface between the road on the approach and the road on the bridge. Mr. Kelley's paper discusses this point to some extent, but without reaching a wholly satisfactory conclusion. Under present conditions, the bridge is usually marked off from the adjacent road by a decided bump, harmful alike to the traffic and to the road. The highway engineer would not tolerate such a bump elsewhere in his road, but he is often forced to accept this roughness at the bridge entrance as the inevitable mark of where bridge engineer and highway engineer meet. Improvement in this matter is going on rapidly, however, and with increased thought to the importance of observing the principle of highway continuity it should in time lead to smooth bridge entrances becoming universal. In the same way, we believe, all features of highway bridge practice will attain higher efficiency when once the axiom that the bridge is an integral part of the highway is made the starting point of bridge planning.

Garbage Disposal Confusion

ST. LOUIS is following Buffalo in its flounderings in the matter of garbage disposal. The other engineering works and services of both these cities—water supply, sewerage, paving—are well administered. Garbage disposal continues a source of trouble, a bone of contention, an insistent ever-recurring problem. Why? Because, as has so often been pointed out in these columns, our laymen city fathers, the country over, do not regard refuse disposal as an engineering problem. Buffalo's problem was discussed in these columns some months ago; St. Louis' troubles are recounted in this issue.

It is only just to the St. Louis authorities to state that they have not altogether ignored their engineering staff in dealing with garbage disposal, for the five-incinerator program was based on an engineering report and the one incinerator thus far built was contracted for, tested and accepted, and has been operated under engineering direction. Questions arise, however, as to whether the engineering staff at St. Louis has really had as full control over this matter as it had in water, sewer and paving design, construction and test, and whether anyone, whether layman or engineer, saw the need of having a thoroughgoing engineering investigation of garbage and refuse collection and disposal made by an acknowledged expert in that field, and of having the type of disposal works selected, designed, built and tested under expert direction.

Failure to obtain and follow expert engineering advice is inexcusable enough on the part of small cities, but for large municipalities like St. Louis and Buffalo to muddle along in matters involving so much expense and liable to cause so much confusion seems inexcusable. If the fault lies with engineers, unwilling to acknowledge that refuse disposal is beyond their experience and to ask for consultants, it is high time it should be known. Our own belief is that fundamentally the blame rests with laymen city officials who either do not yet recognize that refuse disposal is an engineering problem, or who in some cities and for reasons best known to themselves, wish to retain their grip on this class of contract work.

In any case, it is the duty of engineers, in and out of the city employ, to help cleanse the sorest spot in the municipal service.

Tunnels and the Port of New York

A NICE controversy has arisen in New York over the proposal of the Governors of New York and New Jersey that the Port of New York Authority should take over the new vehicular tunnel across the Hudson. When that tunnel was first projected it was conceived of as merely an underwater street connecting the busy trans-Hudson water front cities with the island of Manhattan, a vehicular connection similar in purpose to the heavily traveled East River bridges. While its original projectors had in mind some motor truck traffic between the large Jersey freight yards and the factories, warehouses and wharves of Manhattan, that use was certainly not superior to the use which was expected between Manhattan and the wharves, factories and warehouses of nearby Jersey, or of the passenger car use which has of late been put in the background.

The enormous development of the motor truck in the last few years for delivery of freight from the car in the freight yard to its destination has put a different complexion on the probable use of the tunnel and it now seems that when opened in 1926 it will speedily become crowded with just this sort of traffic. Inasmuch as one of the primary purposes of the Port Authority is to simplify this rail to warehouse transfer it becomes logical that the Authority assume control of the tunnel.

Unfortunately, the problem is not so simple as that statement might indicate. In the first place it would be most undesirable to shift control of the construction of a great public work when it is two-thirds completed. That seems so obvious that it is inconceivable that the legislatures would vote the transfer until at least the tunnel is in operation. But the question of financing is still more important. The Port Authority has no funds, except an annual appropriation for administration. The tunnel on the other hand is to pay for itself out of tolls, which from present indications of traffic, should amortize the entire cost in twenty years. The claim is made, and not without justice, that the present desire to shift control is merely to give the Authority a capital investment on which it can realize, and by the issuance of bonds, say over a period of fifty years, obtain capital with which to proceed to further construction, the tunnel meanwhile remaining a toll road for the whole period instead of becoming free in twenty years.

In spite of the horror this intention, if indeed it be an intention, arouses in the breasts of the motor-truck interests, it is logical enough if with it is taken the equally logical deduction that the rail and delivery charges in the port of New York must eventually be separated and the free lighterage privilege abolished. At that time—which now appears far distant, it must be admitted—the line haul rates into New York will be adjusted to some approximation of their cost and the charge of delivery will be assessed its proper burden. Then to charge for the use of the vehicular tunnel would be a proper assessment on the total charge of delivery. However, when or if such a readjustment of rates ever comes—and it is toward such a readjustment that future planning must be directed—the superior attractions of the rail tunnel to the vehicular tunnel must become evident. In fact, the inevitable result of consistent thinking must be that the rail haul will be fairly continuous into all parts of New York City and those parts which cannot be reached conveniently by rail will cease to be centers of great manufacturing activity, which is a consummation devoutly to be wished by all except those who own real estate in those parts.

These conclusions lead to a criticism of the recent half-hearted recommendation of the Port Authority that additional vehicular tunnels be built across the Hudson. The public comments on those recommendations make it out that the Authority proposes to build five vehicular tunnels. A careful reading of the report shows that the Authority is not clear in its own mind on this question. The report still adheres to the automatic railway tunnel as an eventual idea but without argument therefor and without previous warning it suddenly suggests the justification for five vehicular tunnels by 1942 and then proceeds to discuss these tunnels as though their justification had been established. It is a singularly incomplete statement to come from such a body.

As Col. Wilgus pointed out in the meeting reported in the news pages of this issue, the all rail tunnel is far more rational and economical as a means of getting freight onto and off of Manhattan Island. Other speakers took less tenable ground in claiming that the rail tunnel would reduce congestion in the streets, for that will be true only as far as the rail tunnel will enter buildings to a greater degree than the vehicular tunnel; after all the freight has to be moved on the streets to the places of business and it is immaterial whether it is brought under the river onto the island on trucks or in cars. But the economy is vastly in favor of the rail haul to the freight stations which should be spotted along Manhattan in such locations as require a minimum of street haul.

The whole discussion, too, is somewhat academic and looking far in the future when we consider how much of the present congestion, and therefore high cost, is due to the fact that truck haulage today is practically entirely a daylight proposition. The railroads work at night; why should not the truckmen? For the ten to twelve hours of darkness each day the streets of lower New York and the ferry boats are deserted. Why should we not utilize this readily used opportunity to decrease congestion and move freight cheaply. Why throw away the flexibility of water carriage which has made New York's port successful until the full twenty-four hours are utilized each day?

The proposal to transfer the vehicular tunnel is only a small part of the continuing problem of the Port of New York. That problem was set before the Port of New York Authority. Unfortunately, it seems to us, that body has not lived up to its promise in its three years of existence and it appears to be diminishing rather than increasing in public favor. It has made many and complicated plans, it has sought and partly obtained a degree of railroad co-operation and it has obtained, at a price, a fair amount of publicity. But it has not shown that strong leadership in port planning that its early advocates had hoped. That leadership and a great deal more of co-operation from both private and public interests might be the result of the reform of the Authority into a more representative body, comparable to those in England, where municipalities, rate payers, merchants, rail and water carriers and government all have representation. Unless the Authority as present constituted soon begins to show some constructive force the other type of organization must be looked to for the co-ordination of this national asset, the Port of New York.

Rebuilding a Section of Street Railway at Milwaukee

Company Force Methods and Equipment Used in Reconstruction of Track and Paving — Reinforced-Concrete Paving General and Special Vibrolithic Test Section—Much Labor-Saving Machinery

IN THE RECENT reconstruction and repaving of a stretch of about 900 ft. of double-track line on Green Bay Ave. at Milwaukee, Wis., the Milwaukee Electric Railway & Light Co. had to solve problems in the handling of cars and street traffic, the delivery and storage of material on the work, and the insuring of rapid progress to avoid complaint on the part of storekeepers along the street. The street is 46 ft. wide between curb lines, with two standard-gage tracks spaced 10 ft. c. to c. Fig. 1 shows work of the same kind on another street. The length covered by the reconstruction was closed to street traffic during a period of 35 days. Concrete paving with the vibrolithic system of finishing or surfacing is a special experimental feature on this piece of track work.

Track and Paving—Standard track construction of this company for paved streets, shown in Fig. 2, consists of 102-lb., 7¼-in. T-girder rails laid on long-leaf yellow-pine ties 6 x 8 in. and 7 ft. long, spaced 2 ft. c. to c. Steel shoulder tie-plates, 6 x 9½ in. and ⅜ in. thick, are used on each tie and the rails are secured by ¾-in. screw spikes. Tie rods passing through the webs of the rails are placed at intervals of 6 ft. to hold the gage. Rail joints are welded by the thermit process.

Crushed stone ballast is placed to a depth of 8 in. under the ties, coarse material of 1⅝- to 2½-in. size being used for the bottom six inches. This first layer is thoroughly rolled and then topped with medium-sized stone, ½- to 1⅛-in. size, for tamping and for filling between the ties up to the underside of the pavement base. After the stone ballast has been well tamped with pneumatic tampers a 6-in. layer of concrete is placed as a base for the paving, including a width of 1 ft. outside the outer rails. The paving between the rails is practically flat and is level with the rail heads. On the outside it is ¼ in. below the rail heads and is sloped to the gutters. On grades, cast-iron grated drain boxes are placed across the track at suitable intervals to intercept surface water. These boxes are connected to pipe drains leading to sewer manholes.

Concrete Track Paving—Reinforced-concrete paving for the tracks is standard practice outside of the business district and has been used also in some of the busiest streets with satisfaction to the company and the municipal authorities. The concrete is 10 in. thick, or 7 in. over the ties. No expansion joints are provided, but any surface cracks are filled with asphalt. Flangeway grooves 5 in. wide and 1½ in. deep at the rail head are formed by a templet or screed, giving a bevel from underside of rail head. At turnouts and heavy-traffic intersections wood forms are placed on each side of the rail to leave a space for a line of red granite stretchers to facilitate the removal of paving when track repairs are necessary. These blocks are placed and grouted after the concrete has set.

FIG. 1—RECONSTRUCTION OF STREET RAILWAY TRACK AT MILWAUKEE
Concrete mixer, batch truck and stockpiles on left. Temporary operating track at extreme right.

In ordinary concrete construction, mesh reinforcement is used (Fig. 2) and the surface is finished with a long-handled float and then with a belt. The street is kept closed for ten days after concreting. A longer time might be desirable but it is difficult to convince shopkeepers that the finished street should be kept closed for a longer period. During the placing of concrete the drain boxes are kept covered with burlap.

Vibrolithic Paving—In this system of surfacing, which has been used experimentally in two cases by the street railway company, no steel reinforcement is used. For this surfacing, the concrete is screeded and then covered with crushed red granite of 2- to 2½-in. size which is spread with shovels on the wet concrete, the quantity averaging about 55 lb. of stone per square yard.

Grated wood platforms are laid on the stone, between and outside the rails, and upon these platforms vibrating machines or tampers are moved to and fro by hand until the stone is driven down and the cement is flushed to the surface. In a few minutes the wet

concrete is then so dense that it can be walked upon. This finishing is done under license from the American Vibrolithic Co., Des Moines, Iowa, at a price per square yard of surface, this company furnishing the machines and the railway company furnishing the operators.

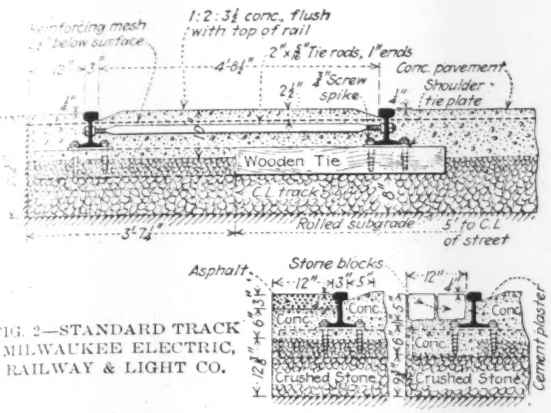


FIG. 2—STANDARD TRACK MILWAUKEE ELECTRIC RAILWAY & LIGHT CO.

Surface finishing is done with an 8-in. steel roller riding on the rails and having a wide bail by which it is moved. A plain roller is used for the strip between the two tracks, while the roller for the tracks has beveled ribs for the flangeways. Finally, the surface is finished with a float or belt. Paving progress, after the track work is completed, averages 300 sq.yd. of double-track line per day with ordinary concreting, or 200 to 250 sq.yd. when the vibrolithic finish is used.

Temporary Tracks—In track reconstruction the company's usual practice is to handle the work in sections about 1,000 ft. long, taking both tracks at once and laying a temporary operating track on one side of the roadway and a temporary construction track on the other side for the delivery of materials by work trains. After these materials have been delivered in stock piles along the side of the roadway the construction track is taken up to make way for the concrete mixer and the machines which serve it. By this method of working the entire stretch of street is closed to vehicle traffic. Where the car traffic is very heavy, it is sometimes necessary to reconstruct only one track at a time, keeping the other track and the temporary track for car operation.

On Green Bay Ave., both work trains and motor trucks were used in delivering material. Motor trucks delivered cement from the dealers' stores and crushed granite for the surfacing from the railway company's yard. Sand, gravel and other materials were delivered by work trains. After the removal of the temporary construction track this side of the street was occupied by stock piles, loading machines and the concrete mixer, as in Fig. 1.

Temporary tracks are composed of 60-lb. T-rails bolted to plank ties and made up in lengths of 30 ft. which are transported on flat cars and handled by a derrick car or locomotive crane. Tierods hold the rails to gage. These track sections are laid on a 3-in. bed of screenings spread on the street paving and their rails are connected by four-bolt splices. Each end of the track is connected with one of the permanent tracks by a portable surface turnout in which the outer ends of the rails are feather-edged and lie on the permanent rails to engage the wheels. A similar surface crossover at each end provides connection of both permanent tracks with the temporary single operating track.

Car movements on temporary single-track stretches are controlled usually by automatic signals, but on the Green Bay Ave. work an operator was stationed at a portable cabin at one end of the section, from which point he could see both ends of the section. A tall standard at the cabin carried a large target with opposite sides painted red and white. When the white target was shown to northbound cars, these cars proceeded until the operator turned the target to show its red side, the northbound cars then waiting to let southbound cars pass over the line. For the convenience of street traffic a detour sign is put at each end of the closed section, with an arrow showing the direction to the nearest through street.

Track Work—Where track is to be entirely renewed, the old paving is torn up between lines 1 ft. outside the outer rails. The old rails (with welded joints) are cut apart with acetylene torches and picked up with a derrick car which loads them on flat cars. For regrading, the ties also are removed, and a small revolving shovel (operated by electricity) excavates the old ballast and loads it into dump cars. New ballast is brought in by similar cars, while ties and rails are brought on flat cars.

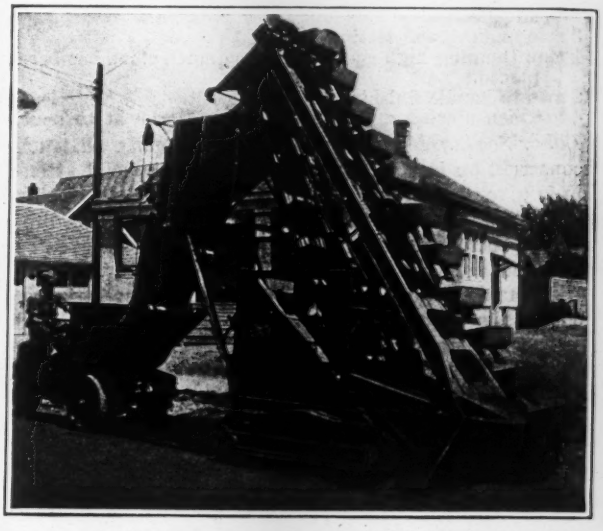


FIG. 3—MECHANICAL LOADER FOR CONCRETE MATERIAL
Machine loads measured quantity of aggregate into batch truck.

Paving Work—For the Green Bay Ave. repaving, sand and washed gravel were delivered by work trains and dumped in long stockpiles on the west side of the roadway. Cement in sacks was brought in motor trucks and stacked beyond the stockpiles. At each stock pile was a loading machine (Fig. 3) mounted on caterpillar traction and having a bucket elevator which loaded a measuring hopper. This elevator was stopped automatically when the hopper was filled. The loading and propelling gears were driven from a gasoline engine. Concrete was made by a 21-cu.ft. mixer mounted on traction wheels and driven by a 550-volt motor. A drop-bottom bucket traveling on a horizontal boom deposited the concrete in place.

Three small trucks with 1-yd. end-dump bodies delivered the batches of material. These were very flexible in movement, being mounted on three wheels. A truck

was run first under the measuring hopper of the gravel loader and then moved forward to the sand loader, from which it proceeded to the cement pile where four sacks were emptied on top of the aggregate. With this complete batch the truck moved on to the mixer, where it turned round and dumped the batch into the charging skip. The method of handling the cement caused considerable dust, and in future work of this kind it is proposed to have a shed with measuring hopper, so that the cement can be handled under cover. The cement may also be placed first in the batch truck, so that it will not be blown off by the wind while being carried to the mixer.

Force and Equipment—On this Green Bay Ave. work the force averaged as follows, working 10-hour days:

1 foreman.
3 batch trucks with 3 drivers.
2 loading machines, each with 1 operator (who also dumped the hopper) and 2 shovelers to trim the stockpile.
3 men emptying cement into trucks and handling full and empty sacks.
1 mixer operator.
3 men placing and spading concrete.
2 men spreading crushed granite on concrete.
2 vibrator operators (4 machines were on the work but only two were operated at a time).
2 men to shift vibrator platforms and screed concrete in advance.
3 men making and setting forms.
1 man tamping high spots where too much stone has been placed.
2 men to handle finishing roller and belt.
4 to 6 men placing and grouting stone blocks at turnout.

Labor-Saving Machinery—Since practically all track reconstruction is done by company forces special attention is given to the organization and equipment for this work. The extent of the company's trackage, the difficulty of securing men and the desirability of greater speed and economy of work have led the railway company to make extensive use of labor-saving machinery. Most of the portable equipment is mounted on special rubber-tired trailers and is hauled from place to place by motor trucks. This mechanical equipment includes the following:

Derrick cars and locomotive cranes.
Motor and trailer flat-cars and dump-cars.
Motor-driven air-compressor outfits mounted on low frames with iron or rubber-tired wheels.
Concrete mixers of 4 to 21-cu.ft. capacity on steel or rubber-tired wheels.
Motor trucks to handle miscellaneous material and to haul portable equipment from place to place.
Small gasoline tractors for special haulage on the jobs.
Electric drills for tierod and bond holes in rails.
Electric tools for boring ties and driving screw spikes.
Compressed air tampers and concrete breakers.
Small three-wheel motor dump-trucks for charging batches to mixers.
Electric portable loader machines for loading concrete aggregate.
Portable rail welding and rail grinding outfits.
Motor and trailer dump-cars, each with three independent boxes or compartments of 5-yd. capacity; the box moves out laterally on either side before dumping, thus throwing its load clear of the track.

Company Force System—In general, the railway company does all its own engineering and general construction work, including not only its tracks but also the design and erection of its buildings and structures. During the 1923 season the track and building force averaged 750 men, including 300 men on additions to the new Lakeside power station. On city work, the men live at home, but three labor camps have been maintained for power house and interurban work. The labor turnover is high, the time of employment for laborers on seasonal construction averaging only 30 days per man.

The company's system includes 94.6 route miles of city and suburban lines and 152.4 route miles of interurban lines, with about 97 per cent double-track on the former and 34 per cent double-track on the interurban lines. Ordinarily the working season is from the end of April to the end of November. All civil engineering, architectural and building work, together with track construction, maintenance and reconstruction is performed by the Way and Structures Department. R. H. Pinkley is engineer of way and structures, and F. G. Hibbard is construction engineer of the way division.

Depth and Spacing of Tile Drains for Farm Lands

Local Conditions Must Govern Practice—General Formulas Not Applicable—Combination Deep and Shallow Tiling

By Emile G. Minder
Drainage Engineer, Slayton, Minn.

A QUESTION of importance in all cases of tile drainage of wet and swampy land is the proper depth at which to place the smaller laterals which collect the water and discharge into the main lateral pipe drains or ditches. In determining this depth, it is not generally realized how many factors are concerned and how much local conditions have to be considered. Several attempts have been made in this state to determine in the field the parabolic water table lying between laterals of different spacings and depths in various soils. The conclusions arrived at, of necessity, are of such a general nature that they add little to the knowledge acquired from general observations which are incidental to the practice of drainage engineering.

This section of Minnesota and a large part of Iowa are overlaid with glacial drift and therefore have soils of very diverse permeability. Some investigators have assumed that the silted soils found in the sloughs and lowlands are of a fairly uniform permeability when weathered, but actual observation over a period of years shows that the assumption is not correct. The silted soil has been eroded from surrounding uplands which have a wide variety of soils with varying degrees of permeability. The general policy that is largely followed is to put in shallow tile with close spacing in tight soils and deep tile with wide spacing in open soils. However, any general formula or statement as to depth or spacing of tile is impracticable so far as this part of the country is concerned.

Determining Depth for Tile—The foregoing general policy as to size and spacing of drains takes into consideration only the physical proposition of getting the water out of the soil to a uniform level as quickly as is feasible. But there are several other considerations which control the depth of the tile. If the soil is fertile to considerable depths, then the lower the water level is put the sturdier and more abundant will be the crops and the better they will be able to resist drought in the summer months. The plant roots will go down through fertile soil to the water, but no further, so that a deeply rooted plant has more root area and greater access to moisture than a shallow rooted plant during drought. Illustrations of this may be found

where attempts have been made to drain sloughs by tiles of insufficient capacity, so that during the spring, when the plants are rooting, the water level has been near the surface, causing the plants to have shallow roots. In the following dryer season, when the tile is of sufficient capacity to draw down the water level, the surface soil in which the plants are rooted dries out and the crops "burn up." When such crops are dug up the roots are found deeply matted and near the surface.

The practical depth at which to place tile in deep fertile soil is an economic question depending on the additional benefit to be derived from the added expenditure. This determination involves the market value of land, cost of tiling, probable value of crops to the producer and other similar factors. The added returns in some soils are considerable and in others are unimportant, so that no definite statement as to depth can be made unless the productiveness of the soil and the general growing conditions are known.

If the top soil is underlaid by coarse gravel, as is largely the case in our river bottom lands, then there is a danger of pulling the ground water level so low that the capillary attraction in the gravel is not sufficient to raise the water up into the top soil. This is a common fault with drainage systems. Thus we find that in dry seasons the crops in these lands "burn out" even though they are well rooted and at the same time crops on adjacent higher lands are green.

Tributary Drainage—Another factor which determines the depth of the smaller collecting laterals is the relation of the tributary drainage area to that of the catchment which is being tiled, and also the manner in which the water runs from this drainage area. If the tributary drainage area is relatively large and sheds rapidly there is a large volume of water to be got into the tile before the crops are injured. If the soil is open, the tiling is laid deep in order to create a large reservoir in the soil which operates until the tile has had time to take off the excess. If the soil is tight, the tile may be placed deep, with frequent inlets, or the tile may be shallow without inlets.

Agriculturally there is a big advantage in allowing the rainfall to pass through the soil to a considerable depth. Again we have the economic proposition of determining the additional benefit to be derived from the added expense. There are certain conditions under which combinations of deep and shallow tile can be worked out. Then the waters from peak floods are discharged through both systems, and after the flood has subsided the deep tile draws down the water table to the desired level.

Many other factors may have to be taken into consideration, such as the desirability of leaching excessive carbonates out of tight soils and thus loosening the soil, drawing down excess alkali from the surface where it has risen during an extended dry period, and other less important conditions. Consideration of these factors is commonly deemed impractical because farm drainage as a rule has been developed merely to the point of removing visible water quickly without noting the effect of various methods of drainage on crop production. The questions usually asked are: Has the tile sufficient fall, and has it a good outlet? When land has been tiled on the basis merely of these two factors and then fails to become productive, it is usually said that this kind of land cannot be farmed or the tile was not properly laid or that floods cannot be provided against. Any number of similar reasons may be given rather than the real common-sense and scientific reasons.

Draining a Slough—In draining a slough, the practical and economical procedure is first to lay tile around the edges, on the seepage line and with about 3 ft. of cover. This seepage line may be located in different ways. Cattle paths around a slough are usually along this line, as the earth is firm enough for good footing and yet soft for the hoofs. Seepage coming to the surface along the banks often causes the earth to fall away below and forms a miniature fault on the surface. The character of the vegetation on the banks may also indicate the seepage line, especially as to the depth of rooting. If the bank is plowed, the seepage line can be located readily by the color of the earth when the ground dries out after a wet spell in the spring, the earth above the seepage line being of lighter color.

Tile lines are run through the depressions in the slough, as deep as the main drains and depth of fertile soil will permit. Parallel tile lines are then interspersed, not more than 600 ft. apart and as deep as possible. After the land has been cropped for a season additional tile lines are laid at locations and depths indicated by crop conditions. This procedure may result in a partial loss of the first crop, but in the long run it is the cheapest and most effective and therefore the most economical way of draining a slough for agricultural purposes. In this way the quantity of tile is reduced to a minimum and what tile is laid will be effective.

Finally, it may be said that combinations of local conditions and circumstances are too numerous to warrant any definite statement or formula as to the proper depth for tile drains irrespective of soil, topographic, climatic and agricultural conditions. The problem resolves itself largely into the proposition of observing nature's manifestations on the ground.

Automobile Congestion in Japanese Earthquake

Automobile congestion in Yokohama and Tokyo contributed to the disastrous effects of the Japanese earthquake of last September, according to Dr. Thomas A. Jaggar, Jr., Director of the Hawaiian Volcano Observatory of the U. S. Weather Bureau. Dr. Jaggar's statement, issued through the Department of Agriculture, says that the streets of the two cities were full of moving and parked cars at the time of the earthquake, and as most of the streets are old and narrow the cars largely blocked movement of traffic in the earthquake panic. The disaster began at noon, when there is always additional street activity, and the automobiles became so jammed that fire apparatus could not get through. Dr. Jaggar also adds: "Hundreds of gasoline filling stations provided fuel for as many fires, as well as the separate tanks of gasoline in each car. It was this condition as much as the earthquake itself which made the Japanese disaster the biggest of all such horrors on record." He considers it only a question of time when the increasing problem of automobile traffic will require all large cities to provide special parking areas or buildings for automobiles, and not allow any machine to stand in the street without a driver at the wheel.

The Motor Road from Haifa to Acre in Palestine

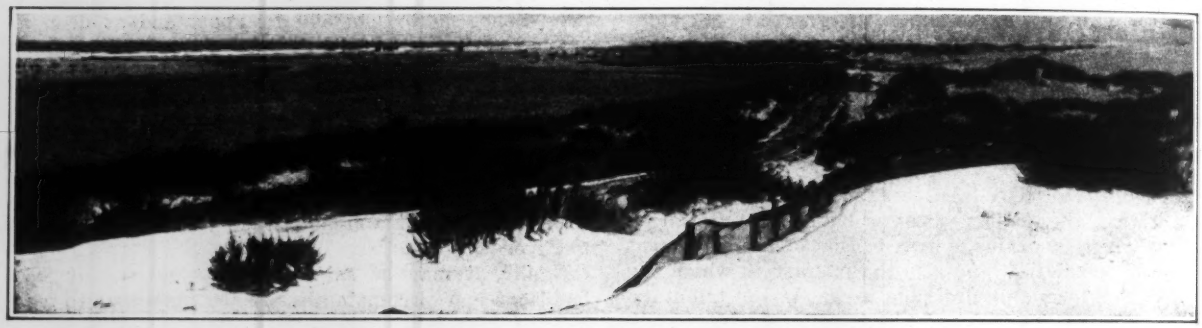
Wire Netting Pinned Over Sand Subgrade Changes to Concrete Slabs With Sand Barriers at Bridge Approaches

By P. W. Etkes
Assistant District Engineer, Public Works Department, Haifa, Palestine

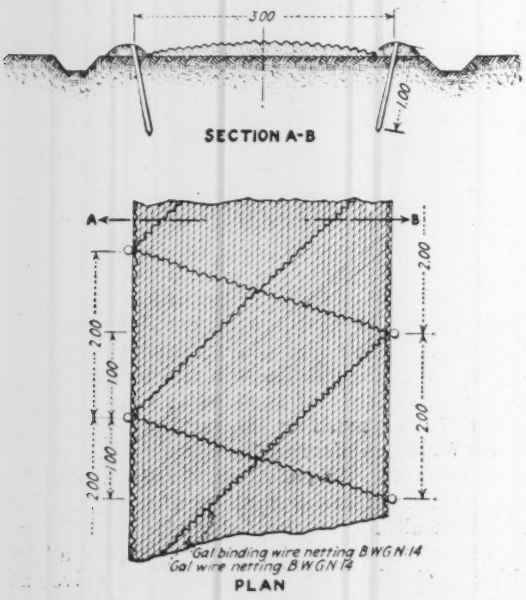
TRADITION says that from time immemorial the only road from Acre to Haifa was the Acre beach. At any rate there is no semblance of any other road. This may be because the low land uniting these ancient cities is swamp and sand dunes and then again it may be because the old shipping kept close to the shores and so encouraged land routes near the sea. It is known that the Romans used the shore road and so probably did the mailed soldiers of the crusades when Coeur de Leon held court in Acre.

As long as Palestine transport consisted only of donkeys, camels and horses the present track was satisfactory and even bridges were not required for these "animals of burden" could easily ford any of the several rivers crossing the way. With British occupation in 1918, things have greatly changed. Today about 4,000 cars—mostly American and mostly Dodges—are speeding (I say speeding for in Palestine all cars seem to try to make the country look smaller than it really is) on the roads. And Haifa is connected with Beirut, Syria, by a road of which Acre beach forms a part. This road is gradually becoming an important link not only with Palestine and Syria but also with Egypt as the railway goes from Egypt to Haifa and many people go from Haifa to Beirut by an automobile journey of some five hours at a cost of about ten dollars.

BUILDING CONCRETE APPROACHES, KISHON BRIDGE
At the right appears the board fence against which the wind builds up an artificial dune as a barrier to drifting sand.



WIRE ROAD ALONG THE KISHON RIVER NEAR ITS OUTLET TO THE SEA
On the right-hand are the real desert dunes. The wire fence is a protection against the drifting sands.

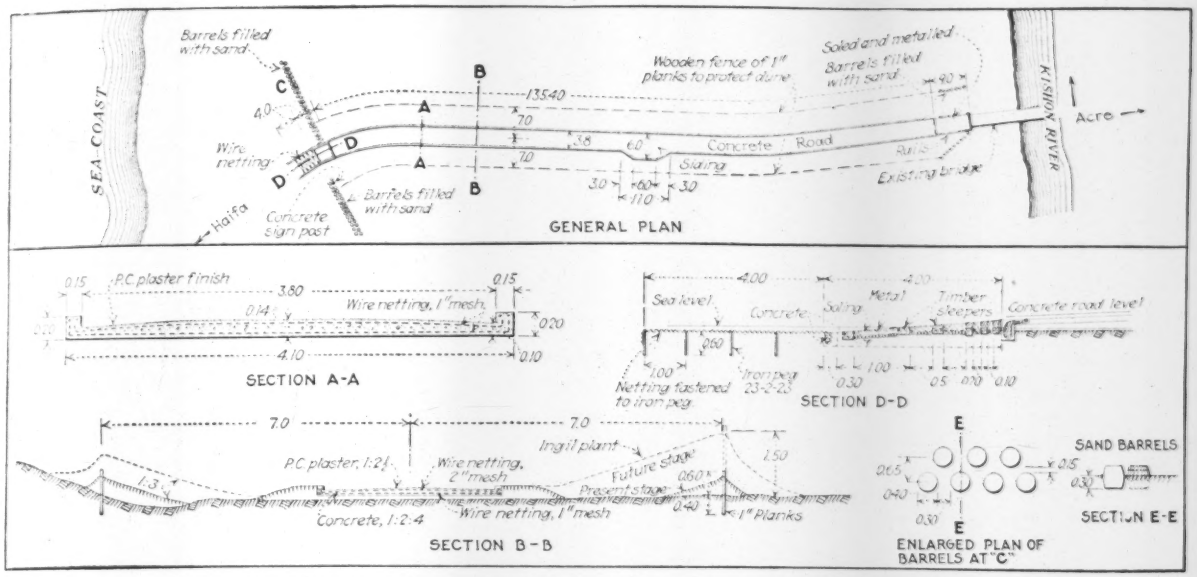


DETAILS OF WIRE NETTING TRACK CONSTRUCTION

As indicated by the map there is a proposed Haifa-Acre main road somewhat inland and closely paralleling the railway. Since Palestine cannot build all its roads in one year it was decided to make the old shore track passable for cars. The problem was to bridge the rivers and make approaches to the bridges. The remainder of the beach was found to do perfectly well, with a wire netting surface, for all cars. The map shows the shore road, the solid black portions being bridges and approaches.

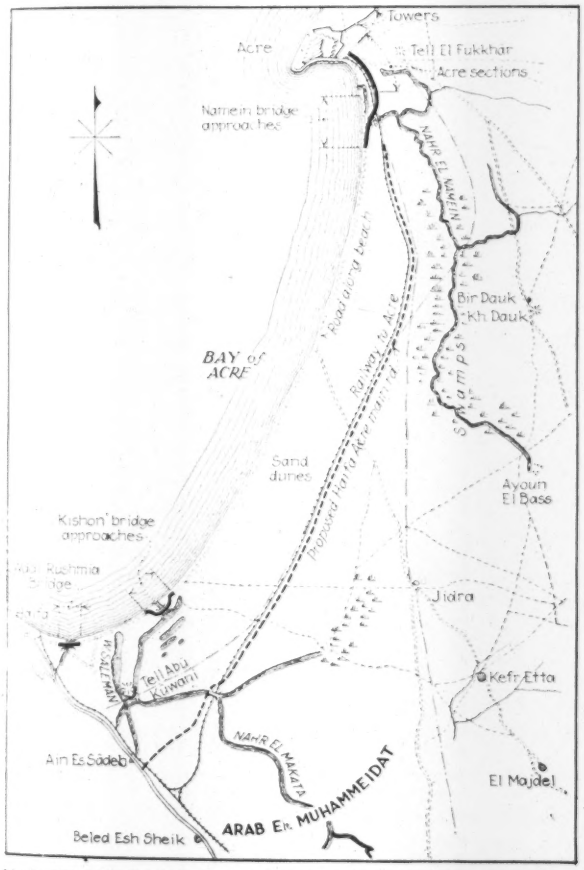
One bridge over the Kishon was built by the British as a military work in 1918. There remained the Wadi Rushmia and the Namein to be bridged. The first was bridged with a concrete girder structure and the second by a timber deck on steel piles. It was not the bridges, however, but their approaches that caused concern to make sure that they are not lost in the sand or covered by drifting dunes.

The drawings indicate how the problem of approaches was solved—a simply reinforced and concrete slab with side protections of artificial dunes met the situation. All



DETAILS OF CONCRETE PAVED APPROACHES TO KISHON BRIDGE

structural details are explained by the drawings but note may be made of the side lip or curb on the slab. This is important for when the wheels once get off the slab onto the sand it is hard to get the car back on the road. Another detail of interest is the transition section from wire mesh road to concrete slab bridge approach. The important detail finally is the artificial sand dune. It is made by putting up a fence of vertical boards. As the sand piles up from the action of the wind the boards are raised. When a suitable height of dune is had it is planted with Nagil grass which holds the sand from drifting.



MAP OF THE ROAD FROM HAIFA TO ACRE IN PALESTINE

The first concrete approach was made to the Wadi Rushmia bridge and found good; then another was made to the Kishon Bridge and now concrete approaches are made to the north side of the Kishon and to the Namein. The concrete roads cost about $2.50 per square meter; this price includes all costs of the work inclusive of the side protections. The cost of cement alone was about $22 per ton on the site, and the average laborer got 75c. per day of nine hours. Sand, per meter cube, cost $2. Stone was gotten for about $2.50 per cubic meter, and the wire netting (reinforcement) at 20c. per meter square. It will be noted that the Public Works Department uses the metric system in Palestine.

A detail of the wire track construction is illustrated. It may be noted that light soil slightly grassed is a good surface for a wire track, especially when some weed is placed underneath the wire netting. However, it goes without saying that horses are to be kept off wire roads. Galvanized wire No. 14, 1-in. mesh, gave good results on these tracks and also rough timber stays for anchorage were found good.

And in conclusion I will add that this road along the Acre Bay is one of the most pleasant in all Palestine though it may not have a built road surface, and anyone going over it will remember it a long time for its sea breeze and the surrounding beauty of a wild nature.

The work described was done under the writer's charge with Peter Noble, A.M.I.C.E., District Engineer, Northern District, Public Works Department of Palestine.

Winter Concrete Construction

The article on p. 986 of *Engineering News-Record*, Dec. 13, 1923, entitled "Fourteen-Story Reinforced-Concrete Hotel Built in Winter Months" should have mentioned that the structure is located at Fort Wayne, Ind.

Garbage Incinerator Program at St. Louis Has Setback

Description and Test Results of First of Five Plants—Objections to Site for Second Incinerator and to Tests

THE PROGRAM for building five garbage incinerators at St. Louis, Mo., met with a setback in September and October, after one of the proposed plants had been in operation for some months and bids for a second had been received. Objections to the site chosen for the second incinerator delayed action on the bids. Then when it was proposed to appropriate $100,000 for motor garbage collection equipment the city comptroller objected on the ground that a complete plan for city

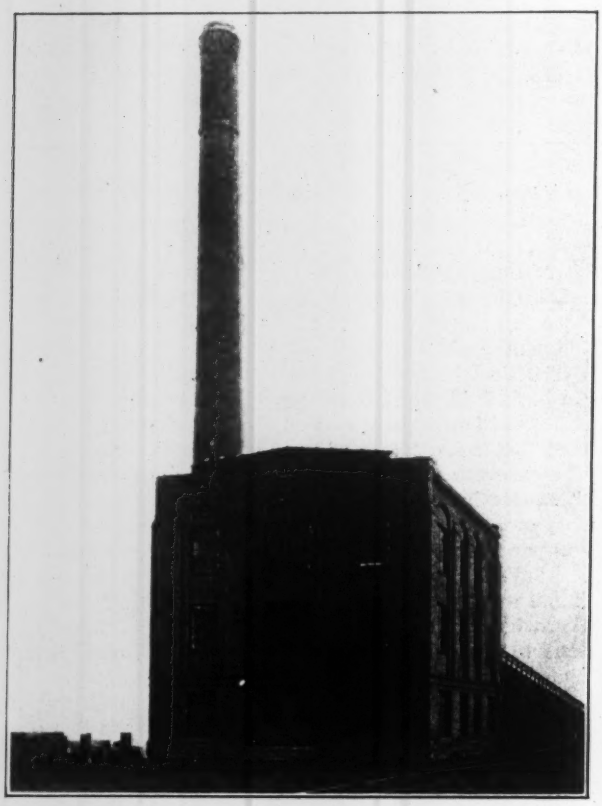


FIG. 1—MUNICIPAL INCINERATOR AT ST. LOUIS

Inclined driveway at rear. The river is at the left but does not show, and just beyond the limit of the picture is the dock where garbage for hog feeding is loaded into barges.

garbage service had not been worked out. As a result of an appeal by the comptroller to the St. Louis Bureau of Municipal Research for data and opinion bearing upon the questions at issue, Jesse D. Burks, then director of the bureau, submitted statements to the comptroller and to the utilities committee of the board of aldermen in which he questioned the sufficiency of the test on which the present incinerator was accepted from the contractor last April. Included in these statements were figures purporting to show that the actual operating results of the incinerator were far less favorable than the test figures indicated. These claims were held to be serious because the total cost of disposal for that part of the garbage hauled to the incinerator had been represented as materially less than the cost of disposing of the bulk of the garbage by contract.

Soon after the criticisms made by Mr. Burks, the incinerator grates failed. This resulted in a shut-down of the plant for some two months (October and November, 1923). The length of the shut-down is attributed to the fact that no one except the director of streets and sewers, who was out of the city, had authority to order new grates. After the plant was again put in use responsibility for its operation was transferred from the Service to the Utilities Department and entrusted to an engineer of the last-named department—presumably Mr. Butts, who is named further on.

There will next be given some information bearing on the adoption of the five-incinerator program by St. Louis, taken from a report made some months ago by Charles S. Butts, engineer of the Department of Public Utilities, St. Louis; a description of the one incinerator thus far built, with extracts from the contract, guarantees and figures intended to show the cost of operating the incinerator under (*A*) the guarantee terms and (*B*) the acceptance test, the latter, we understand, made up by Mr. Butts; and, finally, criticisms of the acceptance test figures and of deductions therefrom, and also some actual operating figures, all by the St. Louis Bureau of Municipal Research.

Historical—From 1839 to 1910 the garbage of St. Louis was dumped into the Mississippi River; the U. S. Government then stopped this practice. Reduction was next tried, first in the city, then in the county, then near Dupo, Ill., but was abandoned in each case. Then came hauling by barge to Chelsey Island for feeding to hogs, and later by rail to Stallings, Ill., and to Summit, Mo., for the same purpose. The present method of disposal and the program for five incinerators are outlined in Mr. Butts' report as follows:

Collection and Incineration—All St. Louis garbage, with the exception of 80 tons per day hauled to the incinerator plant, is being delivered by the city to the present contractors, Klein & Katz, and weighed and dumped onto barges at the foot of Chouteau Ave. There are some 130 wagons in service during the summer months, hauling garbage to this point. The cost, based on 1922-1923 reports, is $3.55 per ton for hauling and $2.10 for disposal, making a total of $5.65 per ton. The present wagons weigh about 2,500 lb. and haul about 1¼ tons of garbage, making the total loaded weight 5,000 lb. or 2½ tons. The hauling of garbage by motor seems to be the solution of garbage collection. A system of trucks and trailers was given a test, but this did not eliminate the mules which were used to haul trailers through the alleys. Another test was made with a tractor and a 3-ton semi-trailer, which made a direct collection and eliminated the mules.

There should be five incinerators built, three of 100-ton capacity on the river front and two of 150-ton capacity in the central west end, thus reducing the long haul, which will greatly reduce the cost of collection during the summer when about 400 tons per day are collected. In summer the plants would have to be operated 24 hours each day, but during the winter months, when 150 tons daily are collected, they would be operated only 8 hr. a day.

When the incinerator plants are all complete and in operation an ordinance should be enacted requiring all garbage to be drained and wrapped in paper before being deposited in the garbage can. This would increase the efficiency of the incinerator plants and eliminate sloppy garbage being hauled through the streets. There should also be an ordinance enacted requiring all hotels to put incinerator plants in their buildings; all large department buildings also should be required to put in incinerator plants, the garbage to be collected daily by the janitors and burned in these plants.

New Incinerator Plant—The new incinerating plant is located on the river front at Chouteau Ave., adjacent to the dock where garbage is loaded into barges. The building, 38 x 56 ft., is of brick with steel roof trusses and concrete footings on 20-ft. precast concrete piles, as shown in Fig. 2. On the first or operating floor are three furnaces 14¾ ft. wide, 11½ ft. high and 32 ft. long, supplied with forced-draft by two fans which draw air from the garbage storage bin and the ash bin. The gases from the garbage pass through a combustion chamber and thence to a 5-ft. brick chimney, 125 ft. high. Beneath the furnaces are 24-in.-gage tracks for small dump cars which receive the clinkers and dust and carry them to fill on the river bank.

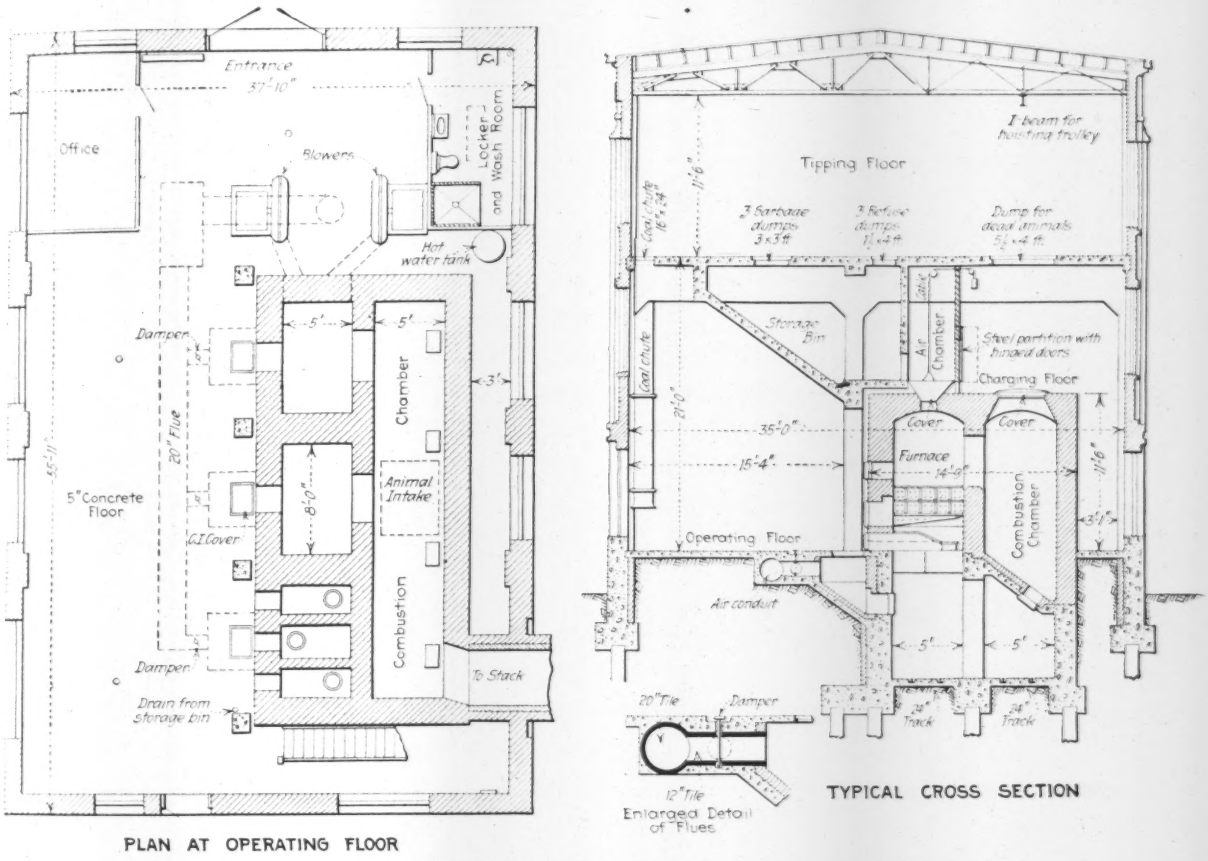


FIG. 2—GARBAGE INCINERATOR OF 80 TONS' DAILY CAPACITY AT ST. LOUIS

Garbage from storage bin is raked to feed-holes over center drying grate. Gases from the three furnaces go to a common combustion chamber in which dead animals are burned. Forced draft is used. Provision is made for the use of coke as fuel when necessary. Clinkers and ash are removed by hand stoking and fall into small dump cars.

On the upper or tipping floor are three holes 3 ft. square for dumping garbage and three holes 1¼ x 4 ft. for dumping refuse, all this material going to a 60-ton hopper-shaped bin 9½ ft. deep. For dead animals there is a hole 5½ x 4 ft. over the combustion chamber. Two coal holes on this floor, with 18 x 24-in. chutes, provide for dumping coal on the operating floor in front of the furnaces. A timber trestle incline with a grade of 5 per cent forms the approach to the tipping floor, and at the street level is a wagon scale by which the garbage is weighed. After being dumped the wagon body is washed on the tipping floor.

Beneath the tipping floor is the charging floor, where garbage is raked from holes in the side of the bin and falls to the furnace through charging holes 25 in. in diameter, having covers raised and lowered by chains. A so-called air-lock is formed by the front wall of the storage bin and an outer steel partition, which partition has hinged doors opposite the openings in the storage bin. The intakes of the incinerator are located inside the air-lock, between these openings. The air used for combustion is drawn from this air-lock and from the bin, so that if any gases should escape from the furnace intake the suction from the fan or blower would carry them away and discharge them into the furnace. As the men on the charging floor stay outside of this chamber or air-lock they do not come in direct contact with the refuse.

Garbage raked to the charging holes falls onto a drying arch from which it is raked to side grates, 5 x 3½ ft. in plan, and then to the firebox 27 x 15 in. and 5 ft. long, making a total grate surface of about 60 sq.ft. Stoking is done from the operating floor. The ashes are raked into a bin and when cooled are discharged into the dump cars already mentioned. Air from the fans is delivered to a 20-in. conduit under the operating floor, with 12-in. branches connected to ducts under the furnaces (see Fig. 2). Each duct has two 12-in. holes under the side grates and a third hole under the firebox. In the combustion chamber a temperature of 1,200 deg. F. is maintained. Heater pipes in this chamber are connected with a tank supplying

hot water for washing purposes and for the toilet room and radiators. With continuous operation in three 8-hr. shifts each crew consists of a foreman, three men on the firing floor and three on the charging floor. In the 24-hour period three hours are allowed for cleaning fires, during which no garbage is charged.

The material burned, Mr. Butts writes, is "100 per cent garbage," as a result of a separation ordinance passed when reduction was practiced.

Guarantees—Under the St. Louis contract the contractor made the following guarantees:

1. That the furnaces as erected will consume at least 80 tons of garbage in 24 hours without the emission of obnoxious odors and will operate in accordance with existing smoke ordinances.

2. That the furnaces will not need more than 6 per cent bituminous coal to incinerate wet garbage and no fuel, save for starting, to incinerate mixed city refuse consisting of 40 per cent combustible rubbish and 60 per cent garbage and other refuse. The maximum amount of electric current needed will be 8 kw. per ton of refuse.

Operating Cost—The operating costs under the guarantee and as based on the test of April 27, 1923, are given in the accompanying table. On the assumption that the test results fulfilled the guarantee the plant was accepted. It will be seen that the cost of incineration

COST OF OPERATING ST. LOUIS GARBAGE INCINERATOR

A. Under Terms of Guarantee

Plant to burn 80 tons of garbage in 24 hours with 6 per cent coal and 8 kw. electric current per ton of garbage.

Coal: 6 per cent = 120 lb. per ton of garbage for 80 tons = 9,600 lb. (or 4.8 tons) in 24 hr. at $5.25 per ton	$25.20
Power: 8 kw. per ton for 80 tons = 640 kw. in 24 hr. at 3½c. per kw.	22.40
Labor: 18 men at $100 per month (three shifts of six men each at 8 hours)	$1,800
3 foremen (one in each shift) at $125 per month	375
Total labor per month	2,175
Labor per day for month of 26 days	83.68
Total cost per day of 24 hours	$131.28
Total cost per ton of garbage	1.64

B. Under Acceptance Test

Plant consumed 26.6 tons of garbage between 8:40 a.m. and 2 p.m. or 5 hr. 20 min. = 4.98 tons per hour; for 21 working hours, 104.10 tons, three hours being allowed for cleaning fires, when no garbage will be charged.

Coal: 10,885 lb. or 5.44 tons of coal consumed = 104.5 lb. per ton of garbage	$28.56
Power: 0.5 kw. per ton for 104.1 tons = 52.05 kw. at 3½c.	1.82
Labor (as above)	83.68
Total cost for incinerating 104.1 tons in 24 hours	$114.06
Total cost per ton of garbage	1.09

is put at $1.09 per ton, but this does not include capital charges or depreciation of plant. The contractor for removing garbage in barges is paid $2.10 per ton. This latter price, however, includes all the contractor's various expenses, with capital charges and depreciation of plant. Against it may be set such revenue as he may obtain from selling the garbage. Criticisms of both the figures just cited are given below.

The contractor for the new plant was the Chicago Incinerator Co., which sublet the furnaces to the Burke Furnace Co., Chicago, and the building and appurtenances to local contractors. Design and construction of the plant were in immediate charge of C. S. Butts, an engineer of the Department of Public Utilities, under James A. Hooke, director. Its operation was under Clinton H. Fiske, director of the Department of Streets and Sewers, until late in 1923, since when it has been returned to the Utilities Department in charge of Mr. Butts. The total cost of the plant was $69,812.

The bids for the proposed second incinerator received last August for a 100-ton plant complete, including furnaces, stack and building, were $69,890, $70,000 and $118,000. The lowest bid was from the Davis Garbage Furnace Co., New York City. All these bids were rejected, following protests as to the use of the proposed site for the incinerator.

Criticism of Incinerator Test—When Comptroller Nolte objected to the proposed appropriation of $100,000 for motorized garbage collection equipment, as mentioned at the beginning of this article, on the ground that the city lacked a complete plan for garbage collection and disposal, he was supported by Jesse D. Burks, then director of the St. Louis Bureau of Municipal Research, who claimed that the report on the incinerator test was misleading both as to the efficiency of the incinerator and as to the relative costs of collection and disposal by incineration and by barging down the river under contract. Mr. Burks stated that three tests were made before the incinerator was accepted. The first two extended over seven hours and were not regarded as satisfactory. The third test, on April 27, 1923, covered only 5¼ hr., although the contract provided for a 24-hr. test. Later there was published in *Mind Your Business* (the weekly bulletin of the Bureau mentioned) for Oct. 2, 1923, a more formal statement, signed by Mr. Burks, the substance of which, including a tabular summary of cost of garbage collection and disposal, is given herewith. The actual cost of incineration for 125 days is compared with the contract guarantees and with figures deduced by Mr. Burks from the acceptance tests. Items left out of account in the city figures are inserted by Mr. Burks. The text of the report, omitting some general matter, is as follows:

GARBAGE COLLECTION AND DISPOSAL COSTS AT ST. LOUIS, MO.

(From *Mind Your Business* for Oct. 2, 1923)

I. Cost of Garbage Collection, 1922-23

Garbage collected, 68,354 tons	Official Annual Report	B. M. R. Verified Data
Collection section	$145,745	$134,412
Stable section	97,226	97,226
Insurance		2,798
Electric power		550
Automobile superintendent		533
Interest and depreciation		33,743
Total	$242,972	$269,250
Cost per ton, 68,354 tons	$3.55	$3.939

II. Cost of Incineration, April-August, 1923

Investment, $73,185 Interest and Depreciation Rate: 10 per cent	Basis of Calculation—125 Days Actual 125 Days	Contract Guarantee	Acceptance Test
A—Operating data			
Garbage capacity, tons	6,568	10,000	13,012
Coal required—tons	1,447	600	679
Power required—kw-hr	56,500	80,000	65,062
Coal per ton—lb.	440	120	104
Current per ton—kw.-hr.	8.6	8.0	5.0
B—Operating charges			
Payrolls	$9,686	$9,686	$9,686
Coal	7,600	3,150	3,569
Power	1,843	2,608	2,121
Supplies, etc.	103	103	103
	$19,234	$15,548	$15,482
C—Fixed charges			
Interest and depreciation	$3,049	$3,049	$3,049
Overhead salaries	389	389	389
	$3,438	$3,438	$3,438
D—Operating and fixed charges	$22,672	$18,986	$18,919
E—Cost per ton	$3.455	$1.898	$1.454

III. Barge disposal, April-August, 1923

Contract—24,160 tons at $2.10		$50,737	
Dump expense—21.4c. per ton		517	$51,254

1. The exclusion of certain elements of cost distorts the apparent cost of garbage collection. The actual cost is $3.939 per ton, not $3.55 as reported—a difference of 11 per cent.

2. Worked at its guaranteed capacity of 80 tons per day, the incinerator would have disposed of 10,000 tons of garbage in the period of 125 days covered by these figures, at a cost of $1.898 per ton. The actual disposal was only 6,568 tons and the cost per ton $3.455.

3. At the capacity reported by the city's engineers—based upon a test run of only 5.33 hours (upon which the plant was accepted by the Board of Public Service as meeting the

guarantee), the incinerator would have disposed of 13,012 tons of garbage at a cost of $1.454 per ton.

4. In no respect has the incinerator, in actual practice, met the guarantee. Two tests of 7 hours each, made prior to the acceptance test of 5.33 hours, made it clear that the incineration was not meeting the guarantee.

5. The total cost of incinerating 6,568 tons of garbage, during 125 days of operation, was $22,672; whereas the total cost of incinerating 10,000 tons, under the terms of the guarantee, would have been $18,986—a difference of $3,686. To this amount should be added the cost of disposal by barge of 3,432 tons at $2.314 per ton, which should have been delivered to the incinerator under the guarantee. The actual loss to the city, by reason of the failure of the incinerator to meet the guarantee, is therefore $11,373 for the five-month period.

6. For a full year, at this rate, the loss to the city on the deficiency in operation of the incinerator is $30,888.

7. Similarly, one year's loss to the city, based upon the deficiency in operation of the incinerator below the standard of the acceptance test, is $44,843.

8. The cost of incineration, for the period of 125 days ($3.455 per ton) is $1.141 per ton in excess of the cost of disposal by barge $2.314 per ton). For one year's operation the cost at the present capacity (15,763 tons per annum) is therefore $17,985 greater than disposal of the same amount by barge at the present contract price.

9. The conclusion seems clear, therefore, that one of three alternatives should be adopted by the city: (a) Suspend operation of the incinerator and dispose of all garbage by barge under the Klein & Katz contract. (b) Correct the defects of management and operation so that the incinerator can operate at its guaranteed efficiency which will reduce the cost to a point 42c. per ton below the cost of barge disposal. (c) Consider the possibility of installing equipment that will permit the incineration of all the city's garbage and the utilization of the heat for the development of power at a profit.

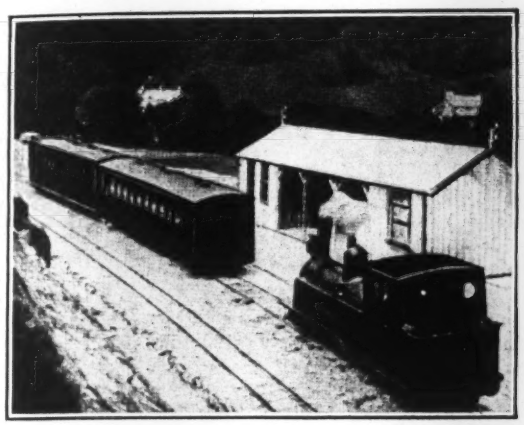
70 M. G. D. Pumping Plant for Australian Irrigation

The South Australian Government is installing two direct-acting explosion pumps (Humphrey design) of a combined capacity of 70,000,000 Imp. gallons per day, for irrigation purposes at Cobdogla, about 180 miles up the Murray River. These pumps are somewhat smaller than the pumps at Chingford, England, the play pipes of these pumps being 5 ft. 6 in. in diameter, as compared with a 6-ft. diameter in the Chingford pump. The Chingford pump, described in *Engineering News*, April 17, 1913, p. 764, was designed for a capacity of 40 m.g.d., and delivered under test 47.5 m.g.d. at a fuel consumption of 0.931 lb. of anthracite coal per water horsepower-hour.

A New British Narrow-Gage Railway

HEAVY grades and curves with loop developments are characteristics of a new British railway of 23½-in. gage, the Welsh Highland Ry., which in connection with the old and famous Festiniog Ry. gives a 35-mile narrow-gage line in the mountainous country of north Wales and passes near Mount Snowdon. From the western end of the 15-mile Festiniog Ry. at Portmadoc the new line extends twenty miles north to Dinas, with a two-mile branch and a probable three-mile extension to the city of Carnarvon. In addition to freight and passenger traffic there is a heavy quarry traffic and in summer this is a favorite tourist route.

A three-mile grade of 3.6 per cent was provided in the original plans for this new line, but a development with long hairpin loops and curves of 198 ft. radius has enabled a maximum grade of 2.5 per cent to be maintained. This grade is about four miles long and the developed length of line is 4.7 miles for a direct distance of two miles. The bridges include 70-ft. truss spans and 24-ft. I-beam spans, one river being crossed by eight of these 24-ft. spans. There are several tunnels, of which the longest is 900 ft. On the old Festiniog Ry. one of the summit inclines was so steep that it was operated by cable haulage, but this was eliminated several years ago by a 2,100-ft. tunnel at a lower elevation. The summit elevation at Pitt's Head is 650 ft., while the southern terminal is near sea level.



THE WEST HIGHLAND RAILWAY; 23½-IN. GAGE

At left: train at Beddgelert station, with passing track. At right: tunnels in the Aberglaslyn Pass.

The track is laid with 40-lb. T-rails in 30-ft. lengths, spliced with 4-bolt fish plates, with 13 ties per rail. No signals are installed but traffic is operated under the train-staff system. There are six passing places, with hand-operated switches having the levers secured by padlocks, the keys of which are attached to the train staffs of the respective sections. Tank engines of the 2-6-2 and 0-6-4 types are used, with passenger cars of the compartment type mounted on trucks and equipped with the Westinghouse and vacuum brakes. Four-wheel cars handle the freight and quarry traffic.

Location and construction of the new line were under the direction of Sir Douglas Fox and Partners, consulting engineers. The contractors were Sir Robert McAlpine & Sons. Col. H. F. Stephens is chief engineer of both the Welsh Highland Ry. and the Festiniog Ry. Financial assistance was given by the government. The railway also owns the rack-railway up Mount Snowden.

Building a Concrete Arch Around An Old Iron Bridge

Lower Chord Used for Rib Reinforcement and Upper Chord for Concrete Floor Forms—Trestle Approach Designed As Continuous Structure With Considerable Saving

By E. H. Harder
Concrete-Steel Engineering Co., New York City

A CONCRETE bridge was completed last year in Pulaski, N. Y., which was erected at the low cost of $5.75 per square foot, including the consulting engineer's and resident engineer's fees, a very low sum considering the present high cost of bridge construction. The new bridge spans the Salmon River about four miles above its outlet into Lake Ontario, and in its construction an old wrought-iron bridge was utilized.

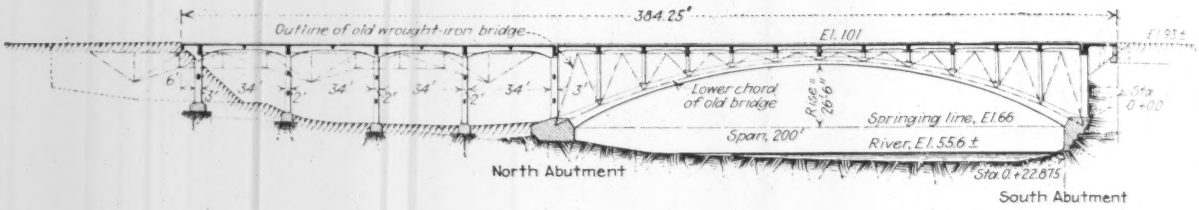


FIG. 1—CONCRETE BRIDGE AT PULASKI, N. Y. BUILT ABOVE AND AROUND WROUGHT-IRON BRIDGE

For the most part of its course, the Salmon River is a meandering stream which has worn its channel through the soft limestone found in that part of the state. In most of its course one bank of the river is steep and precipitous while the opposite bank is more or less filled with river detritus. These conditions prevail at the site of the bridge herein described. The old bridge consisted of a two-hinged wrought-iron arch bridge built about 1882 with a span length between hinges of 216 ft. The south bank of the stream is an almost vertical wall of stratified limestone into which the builder cut a ledge upon which he founded the south bridge shoes with merely a superficial layer of concrete to take up the uneven spots in the ledge. The north shoes of this arch rested on an abutment built of large heavy stone slabs, inclined and at right angles to the arch thrust, the abutment itself resting on bedrock. Between the north abutment of the arch and the extreme north bank of the stream was an approach structure of continuous trusses resting on wrought-iron columns.

The reason for abandoning the old structure was its impaired strength and its antiquity. A more modern structure was necessary to care for the heavier traffic. In spite of its age, most of the metal was in excellent shape. The worst spot was found at the south end where constantly dripping water had caused the metal to corrode badly at the shoe.

Early in the work of designing the new bridge, it was obvious that if the old bridge could remain in place while the forms for the new structure were being built, a considerable sum of money could be saved. The contractor could make use of the old structure in his work of depositing concrete without the use of a cableway, chute or trestle. Since the bridge was started late in the season the contractor could save considerable time if he could keep the old bridge in place. It was therefore decided to design two concrete ribs into which the lower chord of the old wrought-iron arch would be embedded. Following this thought, a 200-ft. arch was developed which enclosed the lower chord of the metal arch. Because the old stone slab abutments at the

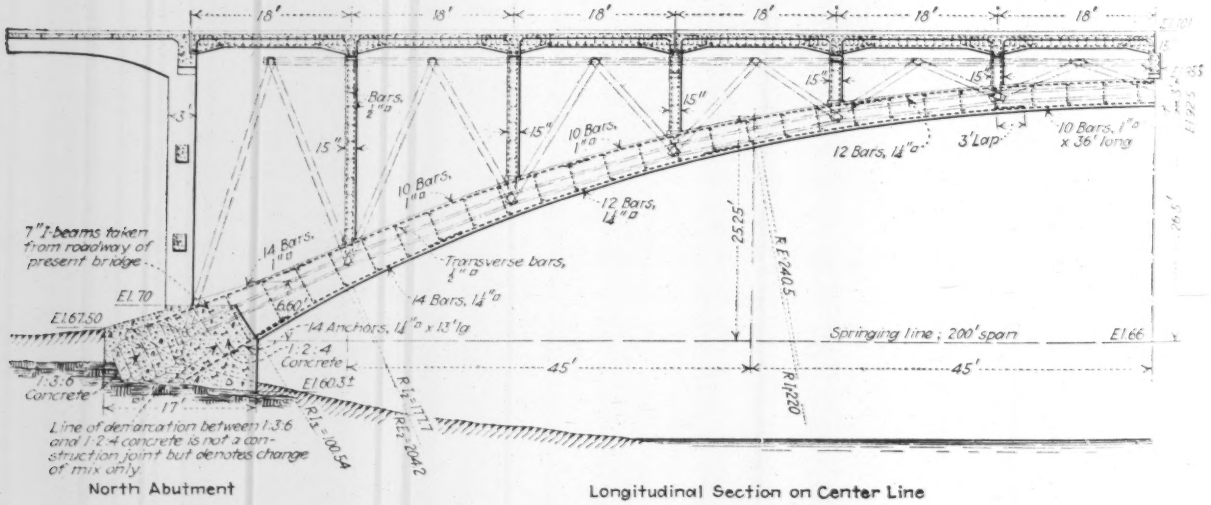


FIG. 2—DETAIL OF DESIGN OF NEW MAIN CONCRETE ARCH

FIG. 3—OLD BRIDGE SERVING AS WORKING PLATFORM FOR NEW CONCRETE ARCH

north end had to be straddled by the new arches, each rib of this 200-ft. span widened from the crown toward the skewbacks.

At the crown, each rib was 3 ft. deep and 5 ft. 4 in. wide, while the dimensions at the skewback were 5 ft. 9 in. in radial depth and 7 ft. wide, the variation in width being considered in the moment of inertia computations. Fig. 2 shows the details of the reinforcing, which consisted of deformed bars of various numbers and sizes to adequately care for the maximum stresses. The sections of the old lower chord being in good condition, this metal was used as reinforcing in the same manner as were the steel bars.

In designing the ribs a uniform live-load of 150 lb. per square foot in the roadway, plus 80 lb. per square foot on the sidewalk, was used, while at the head of this train of loads was placed a 21-ton road roller. Temperature was provided for by allowance for a rise and fall of 30 deg. with a high modulus of elasticity of 3,000,000 lb. per square inch.

As previously mentioned, in designing the arch portion of the new bridge, it was highly desirable to maintain the old structure in place including the deck. This necessitated the spacing of the transverse spandrel walls on 18-ft. centers so that each wall would come directly over a panel point in the old lower chord. By so spacing these walls, the top chord would have intermediate supports between upper chord panel points and so would be better able to carry the forms for the deck of the new bridge. In addition to two top chords for the carrying of the forms and dead weight of the new deck, an extra support along the center line was erected with supports resting on the arch ribs.

Approach Trestle—To replace the old trusses on columns north of the arch, it was decided to build continuous girders on high columns 36 ft. c. to c. or twice the spacing of the walls over the arches. This type of structure was carried out for four spans and the remaining gap between the north end of these girders and the old north abutment was filled with earth, partly because the town authorities wanted such a fill and partly because it was felt that a fill would be cheaper than to continue the girders.

This series of girders was designed as a stiff framed structure, each column being rigidly connected with the continuous girders. This procedure necessitated the computation of bending moments in the columns for loads on one span with the adjacent spans unloaded, and it also necessitated computations for bending due to temperature changes. Fig. 5 shows the curves of maximum bending moments for different positions of the uniform load of 150 lb. per square foot.

In addition to the above considerations, advantage was taken of the variable moments of inertia through-

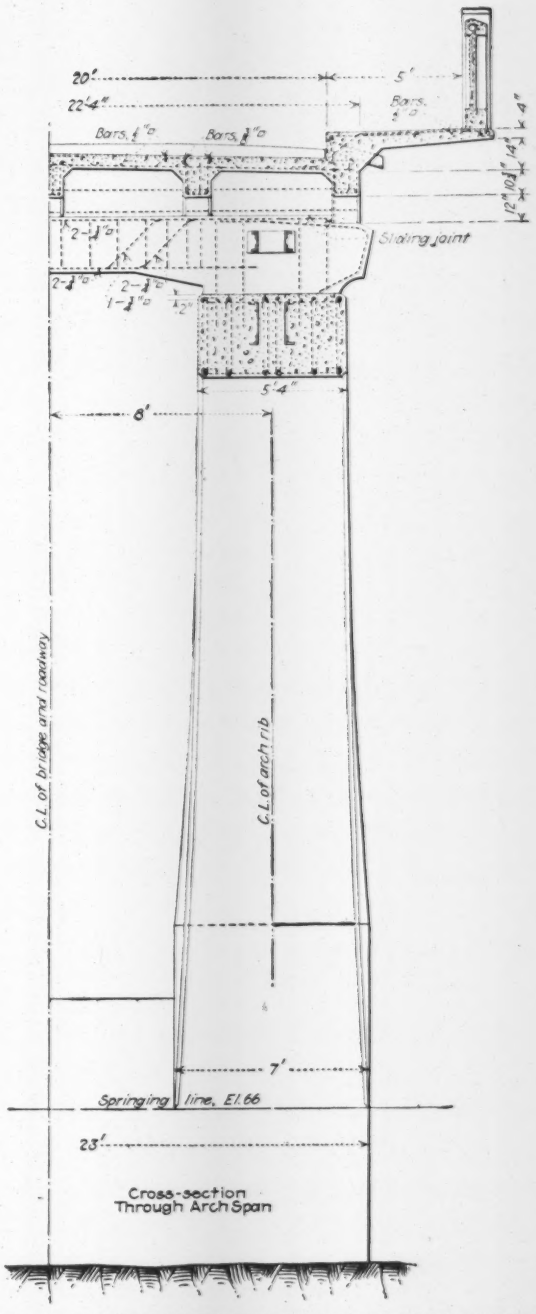


FIG. 4—SECTION THROUGH PULASKI ARCH AT CROWN

out the beam due to the curved haunches at the ends. Fig. 5 affords an interesting comparison of the full line curves for the maximum bending moments for the structure, as described, with the dotted line curves

for maximum curves for a continuous beam of constant moment of inertia and free to slide over supports. These curves show a saving of 28 per cent of the bending moments in the center of each span for the structure as built over the continuous beam, while over the supports the bending moments for the stiff frame structure with variable moment of inertia are 15 per cent greater than the negative moment of the continuous beam of constant cross-section. Since it is generally necessary to deepen a continuous girder over the supports on account of negative bending moment and end shear, it is just as well to give this added stiffness due consideration in the design. By thus considering this greater stiffness at the ends, the points of contraflexure of the continuous beam are moved away from the supports, thus reducing the length of the theoretical suspended center span. This naturally reduces the positive bending moments and reduces the height and weight of the central portion of each span, while on account of the increased leverage the moments over the supports are increased where the greater stiffness and greater depth exist.

The stepped curves show the moments of resistance

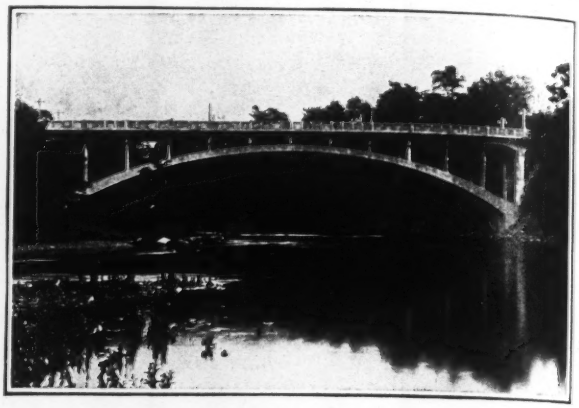


FIG. 6—MAIN ARCH OF COMPLETED CONCRETE BRIDGE

ditions. All of the footings were founded on bedrock.

Floor—The upper deck over the arch ribs presented no unusual problems. Its construction is essentially like that of the continuous girders described above except that more latitude was allowed in designing

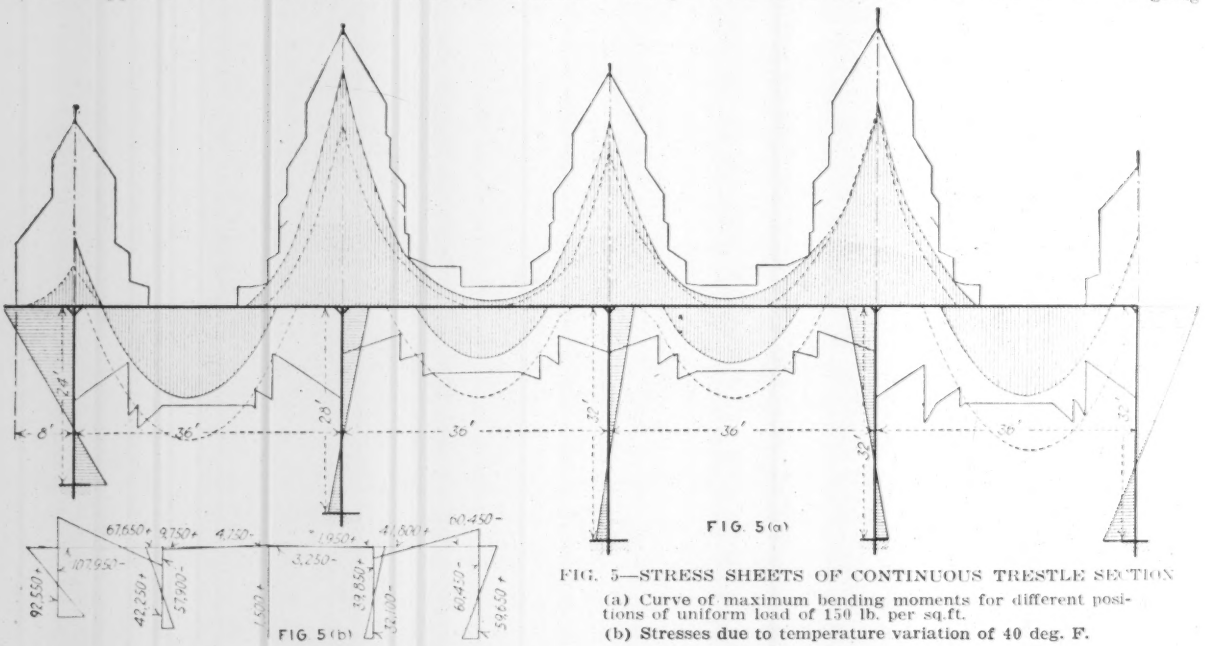


FIG. 5—STRESS SHEETS OF CONTINUOUS TRESTLE SECTION

(a) Curve of maximum bending moments for different positions of uniform load of 150 lb. per sq.ft.

(b) Stresses due to temperature variation of 40 deg. F.

of the sections of the continuous girders according to the steel distribution. These curves rise above the moment curves over supports because the additional bending moments due to temperature changes must be added to the dead- and live-load bending moments.

In the case of the continuous girders, a temperature rise and fall of 40 deg. was considered because the structure is less massive than the arch for which an allowance of ±30 deg. was made. The concrete stresses in the girders were low, the maximum being 586 lb. per square inch over one of the supports and nowhere was 16,000 lb. per square inch in the steel exceeded. The columns were designed for bending and direct compression and the concrete stresses were kept at 550 lb. per square inch.

The footings for the columns were made wide enough and massive enough to permit fixed ended column con-

the sections of these girders because, resting as they do on a yielding arch, it was not considered wise to design these girders with the same regard for the indeterminateness as characterizes the design for the stiff frame portion of the bridge.

Construction—In pouring the arch, keyways were provided at the crown and at the skewbacks. After the bulk of the concrete in the arch ribs had been poured, the keyways were filled simultaneously.

The centering employed was of the usual type consisting of vertical 6 x 6-in. timber columns, timber caps, joists, cross-bracing, etc., of small dimensions. It was first thought that the old bridge could carry a considerable portion of the dead-load of the new arches and the falsework for them but an investigation showed that an independent falsework would be necessary. Preliminary to founding the falsework posts, wash bor-

ings had indicated rock at a depth of about 8 ft. below low water. Piles were out of the question on account of the expense and the difficulty of driving them under the old arch. The contractor decided on spread footings, and since the river bed consisted of river gravel of all sizes and well compacted, it was believed best to place such footings on top of the gravel and not disturb it by digging holes. Since the average load carried by one bent of the falsework was 30,000 lb. it was decided to build concrete footings 2 ft. wide by 9 ft. long and 12 in. deep, reinforced by steel bars, giving a unit load of 1.6 tons per square foot. A test footing of 4 sq.ft. was built and loaded with six tons without undue settlement. In the deeper part of the river concrete footings were built 2 ft. wide on top, 3 ft. on the bottom, and 9 ft. long.

That this method of founding the centering posts was justifiable is borne out by the record of deflections. Due to the dead weight of the concrete alone, the settlement in the centering (including foundation settlement) was ¼ in. at the crown of each rib.

After the erection of the upper deck, the top chord and diagonal braces of the old arch were removed by acetylene torches and all holes made in the arch extrados were carefully patched.

The architectural features were kept extremely simple. At the same time, it is believed that the proportions of the two sections of the bridge and the methods used of harmonizing them has made a pleasing structure.

The parapet is likewise simple. The authorities of Pulaski wanted a high railing to shield pedestrians from the high winds sweeping over the lake. To reduce the dead-load of this parapet, the panels were made 2½ in. thick and were cast off the work under cover and protected by heat during the winter months. A special gravel aggregate was used, and while still green the outer skin of concrete was removed, thus exposing the pebbles and making a decided contrast with the cast-in-place base, posts and top rail.

The total cost of the bridge which is 435 ft. long from end to end and 32 ft. wide out to out of sidewalk slabs was $80,000, including the fill and engineering expenses. Per square foot of projected horizontal area, this cost was $5.75.

The bridge was designed by the Concrete-Steel Engineering Co., New York City. The resident engineer for the designers was Charles F. Bornefeld. The contractor was G. W. Thompson of Syracuse, N. Y., while A. E. Wynn was engineer for the builder and Oscar Mattys was superintendent.

Trainshed Roof Collapses Under Heavy Snow Load

FAILURE of a trainshed roof at Chur, Switzerland, Jan. 10, 1924, is attributed to a very high snow load on the roof, in conjunction with unsuspected weakness of cast-iron bracket and truss parts. A preliminary account of the accident was published in *Schweizerische Bauzeitung* of Jan. 19. The structure was built in 1859 and consisted of timber combination trusses of 44-ft. span carried on oak columns. The chord timbers were of pine, the tierods of wrought iron, and the connecting and bracing members of cast iron, the roof covering wood sheathing covered with tile, and the roof slope 25 deg. The whole 170-ft. length of the structure fell simultaneously, as far as could be learned. Because of the necessity for speed in clearing away the wreckage to restore traffic, it has not yet been possible to determine what was at fault, but it is known that there was no serious rusting or decay. Most of the tierods, says the report, were found entire, while most of the cast-iron parts and members were broken to pieces. The tierods apparently were fastened to the cast-iron members which formed the bracket connection between truss and columns, and for the present the accident is attributed to failure of one or more of these end connection pieces. Old cracks were found in a number of them. The watchman reported that half an hour before the collapse he heard a cracking noise in the structure and noticed that a bracket had broken. Measurements and weighings of the snow on the adjoining station building, immediately after the accident, showed a depth of 20 to 28 in. and a weight of 38 to 50 lb. per square foot, the higher amount including the weight of ice layers in the lower part of the mass. The government regulations require that at an elevation corresponding to that of Chur provision must be made for 18 lb. snow per square foot, while the actual snow load in this case was 2½ times as great.

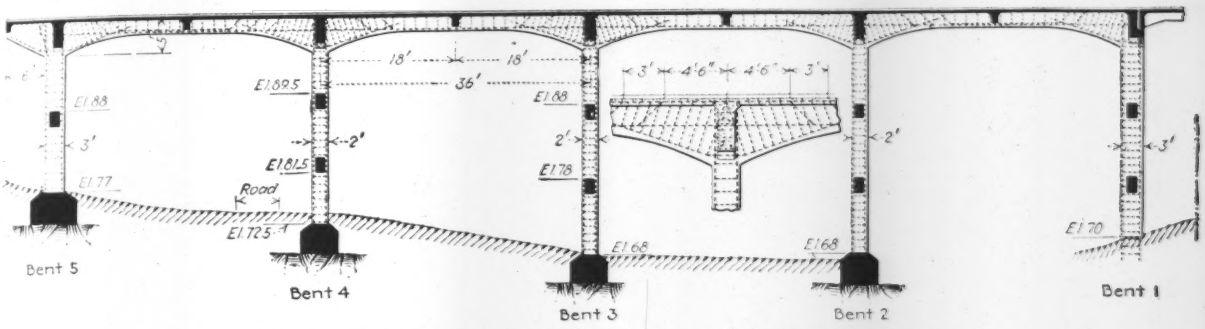


FIG. 7—CONTINUOUS APPROACH TRESTLE TO PULASKI BRIDGE

U. S. Government Profits in Land Sales

The revenues secured by the United States Government in the sale of its public lands have been tabulated by the Department of the Interior through the General Land Office. The figures representing receipts and expenditures since the beginning of the nation's history up to June 30, 1923, show that the net profits amount to $339,411,874. The aggregate receipts from the sale of public lands total $491,300,484 exclusive of sales of Indian lands, while expenditures reached $151,888,609.

Large Terminal and Cold-Storage Warehouse at Duluth

Rail and Water Terminal—Reinforced-Concrete Structure with Some Steel Framing — Traffic on Two Levels — Perishable Freight — Cold Storage Insulation — Freight-Handling Equipment

EXTENSIVE facilities for the receiving, shipping, local distribution, warehousing and cold storage of both general and perishable freight have been provided at Duluth by the new McDougall terminal warehouse, which provides 350,000 sq.ft. of storage area, 1,000,000 cu.ft. of cold storage space, direct rail and water connections and a union freight station for the use of tenants, with free switching and trap car service. This combination of facilities or service is of particular value at Duluth, which is an important distribution point for the Northwest and is at the head of the connection of lake navigation with several railroads. There is thus a large amount of transfer business, and much freight must be held or warehoused before it is purchased and shipped. A view of the building and its approaches is given in Fig. 1 and a plan and longitudinal section in Fig. 2. A cross-section and part plan of the cold-storage portion of the building are shown in Fig. 3.

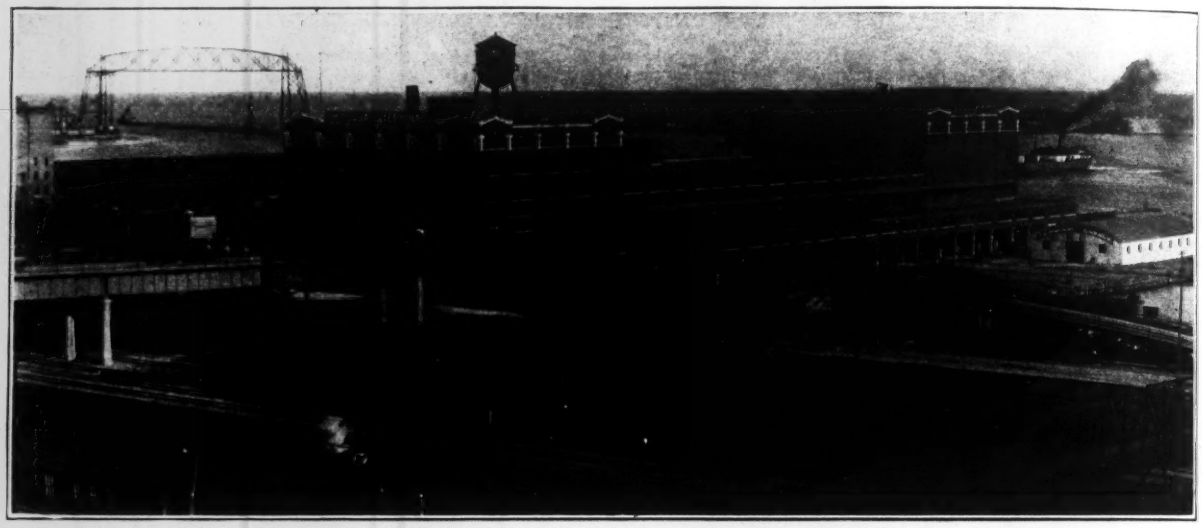


FIG. 1—McDOUGALL TERMINAL WAREHOUSE AT DULUTH

Tracks and driveways on first floor. Warehouse driveway outside third floor with viaduct to Michigan St. Incline connects two traffic levels. Dock at rear of building. Cold-storage section at right. Power house at left, with transporter bridge over harbor entrance beyond. The ice making and refrigerating plant is in the separate power house.

The main building, of reinforced concrete, is 500x172 ft. in the lower portion and 500x128 ft. above, with the ends six stories high and a four-story central section which is designed for two additional stories when needed. There is sufficient headroom for a basement about 7 ft. high, with floor above water level, if this additional space should be required later. The wider lower portion constitutes a two-story annex 45 ft. wide, the roof of which forms a team driveway outside the third floor level of the main part of the building. This is shown by the cross-section of the cold storage building, Fig. 3. Three interior railroad tracks for fifteen cars each extend through this side of the building at the first floor level. On the opposite side is a 14-ft. dock or wharf between the building and a slip 120 ft. wide, with 24 ft. of water and a dock wall about 400 ft. long. Freight handling equipment is provided and there is an ice making and refrigerating plant in a separate power house building.

Topographical conditions make two floors accessible from the streets, as shown in Fig. 1. The first floor is level with Railroad St., along the waterfront, and forms a freight station with facilities for cars, vessels and wagons or motor trucks, so that all handling and transfer of freight is done under cover. The upper floors are for warehouse and storage purposes. The "dry storage" space shown on the drawings is for farm machinery, automobiles and trucks. About 500 ft. north is Michigan St., level with the third floor. This floor, which is connected to Michigan St. by a viaduct across a series of railway tracks, is used mainly by a group of merchants as a warehouse for fruits and other perishable freight. There are several wholesale concerns housed in the building and most of them are so located that their main store fronts are on the viaduct side of the building.

The 500-ft. viaduct ends in a 44-ft. driveway with a 7½-ft. shipping platform extending along the west side of the building (see Figs. 1 and 3). At the north end of the third floor are the main offices of the warehouse company, accessible from the viaduct. This viaduct has steel bents and framing, cased in concrete and carrying a concrete deck. Outside of the north end of the building is a driveway on a timber trestle incline of 10 per cent grade, by which trucks can pass from the first to the third floor level. The original plans provided for an elevator to handle trucks between the first and third floors.

Two of the three interior tracks provide specially for perishable freight and are served by an island platform 18 ft. 9 in. wide, having four elevators which extend to the warehouse or distribution space on the third floor. The third track, with 5-ft. platform, is

for general freight and serves the trucking portion of the first floor, which portion is shut off from the tracks by a tile partition wall having doorways 8 ft. wide. By this arrangement there is a complete separation of perishable and non-perishable freight. An inside driveway extending across the north end of the building and opening from Railroad St. enables wagons and motor trucks to stand under cover at the platform or trucking space of the first floor. Toilet rooms are arranged on the second floor.

Structural Design—Reinforced-concrete construction of the flat-slab type is used for the building, except for steel framing at certain long spans as noted below. provide a 2-in. slot for expansion and a space of 5 or 7 in. for cork lining. The floors of the cold storage section are separated from and supported independently of the adjacent floors and the other part of the building. Their supports are columns spaced about 4 ft. c. to c. from the adjacent interior columns and about 35 in. from center of side columns to interior face of wall columns. This arrangement is shown in Fig. 3, with details in Fig. 4.

Exterior walls of red pressed brick and white terra-cotta inclose the structure and conceal the concrete framing, except that at the south end common brick is used and is flush with the concrete, so that the faces

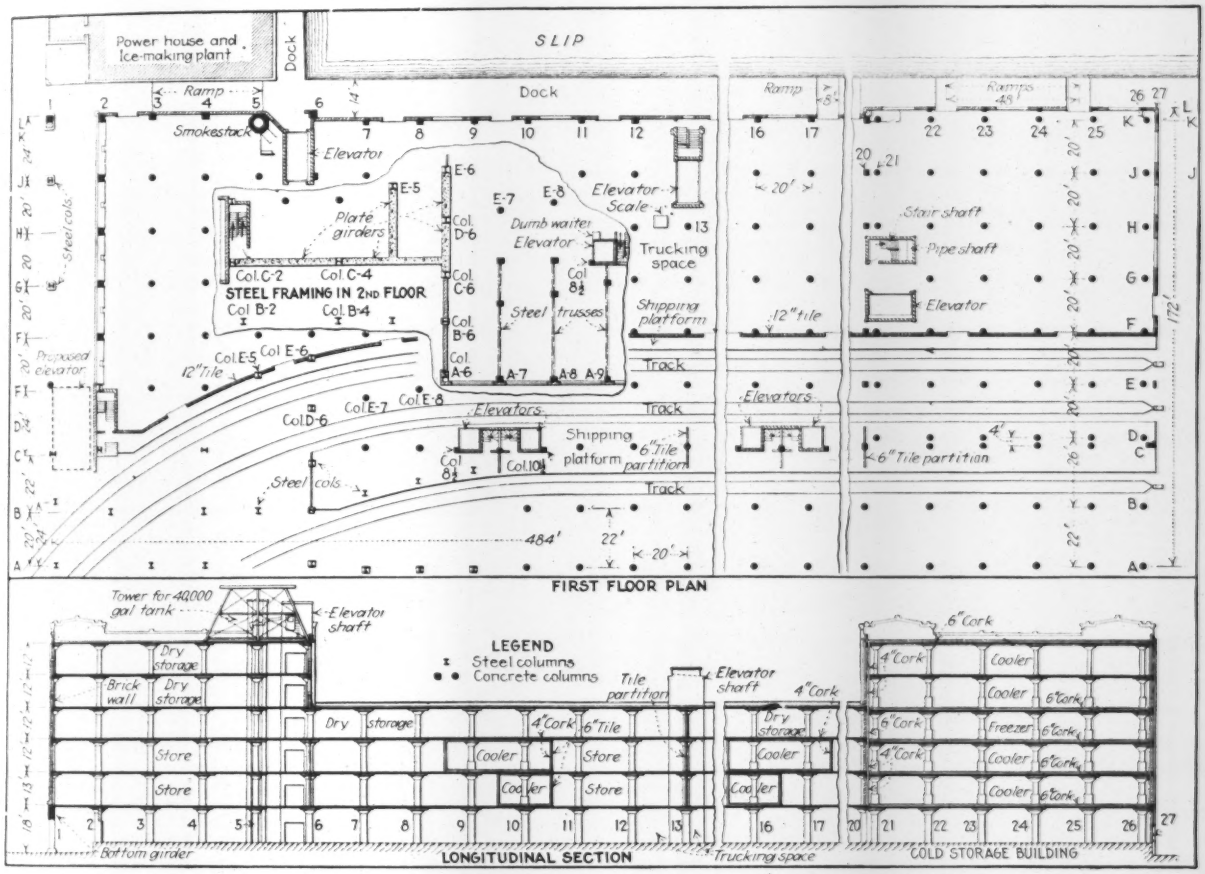


FIG. 2—FIRST-FLOOR PLAN AND LONGITUDINAL SECTION OF WAREHOUSE

Timber piles form the foundations for the wall and column footings. The column spacing in general is 20x20 ft. Wall columns are rectangular and interior columns are circular in section, with flaring heads and drop panels. Floor slabs are 9 in. thick on all upper floors and designed for 250-lb. live load. On the first floor, the shipping platform has a 6-in. slab for 150-lb. loading, but the trucking space has a 9-in. slab for 250-lb. loading. The roof has a 6-in. slab with tar and gravel composition roofing.

Special construction is employed to isolate the south end section which is devoted exclusively to cold storage purposes. These details are indicated in Fig. 4. To provide for expansion and contraction movements and to permit the cork lining to extend continuously from one story to another the floors in this section are separated from the outside walls by open joints which of columns and beams are exposed. Interior partitions are of hollow tile. The walls and partitions in the cold storage section are plastered and finished with lime whitewash to sweeten the air. In other sections the plastering is given a kalsomine coating. Although the power plant is in a separate building, 12 ft. distant, the 84-ft. smokestack is located in the main building and is utilized as one of the wall columns. This arrangement was found to be more economical than the construction of an independent smokestack. The flue is lined with firebrick for the full height of the building.

Steel Framing—At two parts of the first floor special conditions require long spans and here steel framing is used, as shown in Fig. 2. Since the railroad tracks enter the north end on a curve, it was necessary to omit certain first-floor columns and to have an irregular spacing of others in order to give the necessary clear-

ance. At this corner of the building, columns of H-section built of structural steel support box plate girders 96 in. deep and carrying a floor framing of I-beams. Beyond these are three trusses extending from the second to the third floor.

At the teamway across the north end, alternate columns were omitted in the first story in order to give ample room for trucks entering this space. Steel box girders of 40-ft. span and 96-in. depth were introduced, therefore, to support the front wall of the building over these wide openings. Steel columns were used to support the girders, partly on account of their smaller size as compared with concrete columns, but mainly to provide the proper structural connections for the girders. All steel columns and girders are fireproofed by concrete casing, the columns being finished to a rectangular section.

Floors—A 1½-in. cement finish is used for all floors except that a 2-in. layer of asphalt mastic is placed on the driveway, this material being considered preferable where there is much trucking. For the cement finish the Kalman system is used, in which the wet concrete is covered with burlap and on this a layer of 1:1 cement and sand to absorb excess water quickly. After about twenty minutes this covering is removed and the concrete is tamped by motor driven floats which bring sufficient moisture to the surface for the trowel finishing. This process hastens the work and is claimed to secure an exceptionally hard surface by enabling the entire operation to be completed before the cement takes its initial set.

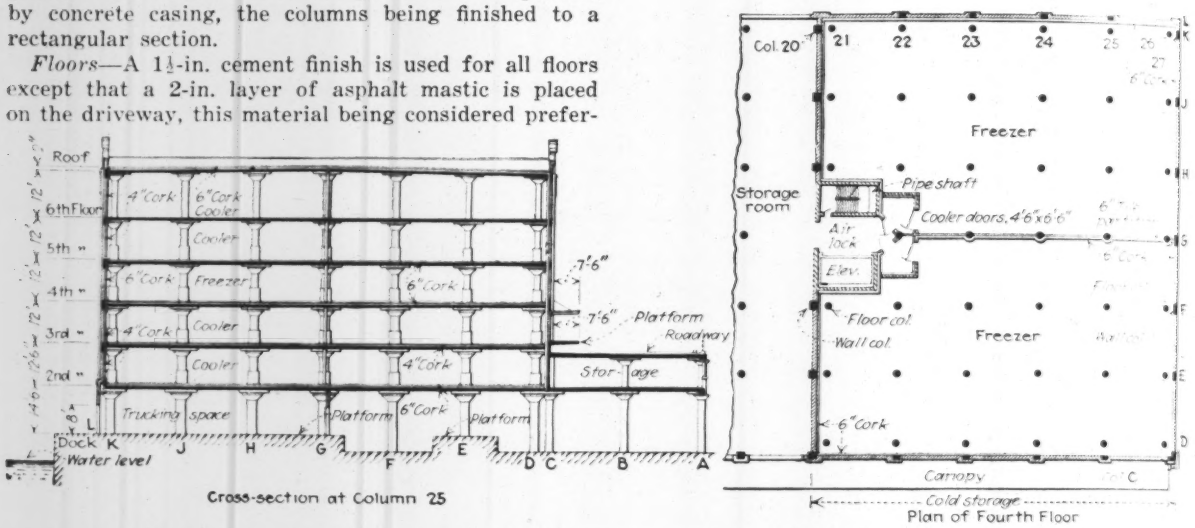


FIG. 3—CROSS-SECTION AND FOURTH-FLOOR PLAN OF COLD-STORAGE BUILDING

Windows and Doors—Steel sash in continuous rows is used for exterior windows, with a certain proportion of hinged sash for ventilation and with wire glass where required by city ordinances. No skylights are provided. Doors in the outer walls at driveways and shipping platforms are mainly horizontal folding doors, 7x8 ft., but some of these at the loading platform on the third floor are folding doors with vertical joints. Each horizontal folding door is composed of two steel panels hinged at a horizontal joint, and the bottom of the lower panel has lugs which slide in vertical grooved guides. The upper panel is glazed. The vertical folding doors are of wood, for openings 10x8 ft., and were adopted on account of the headroom and clearance required at these particular openings.

Steel swing doors are used in interior partitions, and horizontal tin-clad rolling doors of fireproof construction are provided at elevator shafts and interior fire walls. Doors at openings to elevators are of the horizontal trolley suspended type and these openings are also equipped with semi-automatic safety gates. The doors of the four elevators on the shipping platform, however, are of the rolling type and are not equipped with the safety gates. Entrances to the "freezers" have vestibules and double doors, but the entrances to coolers have single doors of the refrigerator type.

Cold Storage Rooms—The main provision for cold storage is in the south six-story section, the whole of which above the first floor is devoted to this purpose (see Fig. 3). The fourth floor is a "freezer" section kept at 5 deg. above to 10 deg. below zero for the storage of butter, meats, poultry and frozen eggs. The other floors are for coolers or cold rooms at about 28 to 35 deg. F. Each floor is divided into compartments by tile partitions, forming rooms to meet special requirements for the storage of fruit, furs, etc. In addition there are smaller coolers or cool rooms on the second and third floors of the central section for the use of tenants in the handling of their daily business and for perishable goods which are held only for a short time.

As explained above, the floor slabs in the main cold storage section are isolated and insulated from the adjacent floors and side walls (see Fig. 4). The entire space of this cold storage section is surrounded by 13-in. brick walls, which are lined with 4 or 6 in. of compressed cork covered with a surface finish of plaster. For the floors the 9-in. concrete slab is covered with 6 in. of cork and then the 3-in. concrete surface finished by the process already described. No cork is used in the slab of the sixth floor, since both the fifth and sixth stories will be kept at about the same temperature. A cork layer is used in the roof. The smaller cool rooms in the other part of the building have 6-in. tile walls with 4- or 6-in. cork lining.

Except in the small cooler rooms on the second and third floors no cork is applied to the ceilings, such insulation being made unnecessary by the floor slots which permit the wall lining of cork to pass through and connect with the cork layer in the floor, thus forming a continuous insulation for each room. The

vestibules on the fourth or "freezer" floor are insulated on both floors and ceiling. The first layer of cork on concrete or brick is laid in cement mortar; the second layer is laid in hot asphalt and fastened in place with wood skewers. All exposed cork surfaces are covered with cement plaster. Columns in the main cold storage section have a cork wrapping to a height of 4 ft., protected by sheet steel jackets.

Exterior doorways to the cold storage section are provided only at the third floor, where there is a vestibule entrance to the elevator and stairway. On the second floor there is a doorway 4½x6½ ft. in the east wall to permit handling material directly from boats. A concrete shaft against the interior partition wall of the cold storage section contains an elevator 7½x15½ ft., a stairway and a pipe shaft. The space between the elevator and stairway at each floor forms an air lock, single-acting refrigerating machines of sufficient capacity to maintain 700,000 cu.ft. of storage space at temperatures of 15 to 30 deg. F. Two boilers supply steam for the ice plant and for heating the offices and certain parts of the warehouse building, which are fitted with radiators and steam coils. This plant can also manufacture 25 tons of ice daily.

Two 5-ton dock cranes of the semi-portable type travel along the 14-ft. dock and provide for loading and unloading vessels. A revolving crane is mounted in fixed position on the traveling bridge or girder; one end of the girder is supported on a steel bent with wheels traveling on a rail at the edge of the dock wall while the other end is supported directly on wheels which ride on a runway carried by concrete brackets at the second floor level. Each crane has a lift of 60 ft. and a maximum working reach of 33½ ft.; it can hoist a

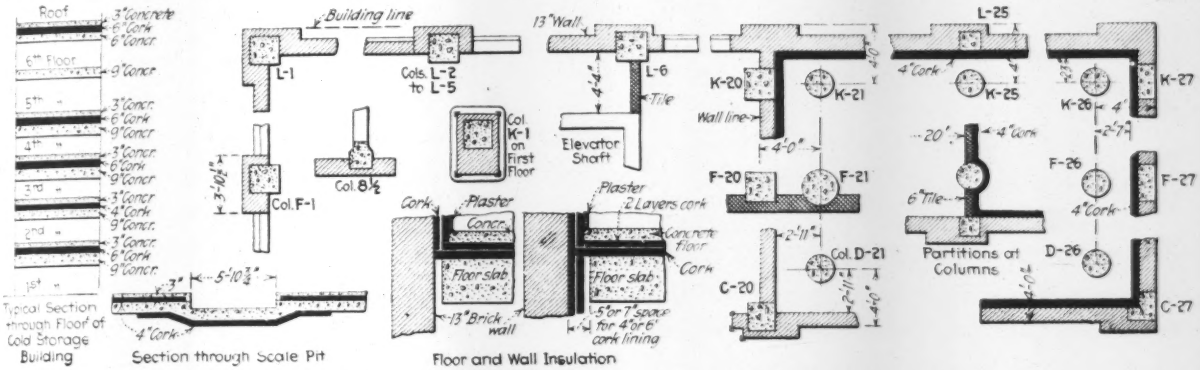


FIG. 1—COLUMN ARRANGEMENTS AND COLD-STORAGE INSULATION

closed by spring doors leading into the two cooler rooms.

Mechanical Equipment—Seven electric elevators and four dumb waiters serve for movements between the several floors. Four 3-ton elevators 8x8 ft. extend from the train platform at the first floor to the third floor, and provide for handling perishable freight exclusively. Alongside these elevators are four hand-operated dumb waiters 3x3 ft., of 200 lb. capacity, with 3x6-ft. doors. These serve the second and third floors only and are for the use of the commission merchants. Three 3-ton elevators 7½x19 to 8½x14½ ft. extend the full height of the building; two of these are for general purposes and the third is in the cold storage section. One of the former is accessible from the boat deck. They run at 185 ft. per minute. Each elevator has an operator, operation under control of truckers not being desirable. All elevator doors and shaft doors have safety stops so arranged that a car cannot be started until both doors are closed and latched. The shaft doors travel horizontally, suspended from overhead trolleys.

Freight platform scales of 3,000 lb. capacity are provided on the first and third floors, the floor slab being recessed or dropped to form a 13-in. scale pit 4x6 ft., as shown in Fig. 4. No wagon or car scales are provided. A 40,000-gal. steel tank on a steel tower above the roof of the building serves the sprinkler equipment which is installed throughout the building. Interior piping is supported by hangers attached to inserts or expansion bolts in the concrete floor slabs.

The one-story power house, 30x60 ft., of steel frame and brick construction, contains two steam-operated 3-ton load at 175 ft. per minute and travel with this load at 100 ft. per minute.

To connect the dock with ship's decks at different levels, there are ramps in the dock wall from which gangways can be laid to the deck or side hatch. Mechanical gangways with conveyors for packages or trucks may be installed if required. Small motor trucks for warehouse service will be installed later, when the requirements are fully understood, but it was considered desirable to have a year's experience in operating the terminal before introducing mechanical equipment of this class.

Owners and Builders—This warehouse plant, costing about $1,500,000, is owned and operated by the McDougall Terminal Warehouse Co., Duluth, Minn., of which A. Miller McDougall is president. The company is also operating a line of oil-engine electric-drive motor vessels between New York and Duluth, these boats being of 2,600 tons cargo capacity including 600 tons in cold storage.

The architect was S. Scott Joy, Chicago, and the general contractors were Jacobson Brothers, Duluth. Pile driving was started Aug. 1, 1922. Although construction work was delayed by a fire in the falsework for superstructure on Jan. 4, 1923 (see *Engineering News-Record*, June 21, 1923, p. 1084), the building was completed and ready for occupancy on May 1, 1923. To accomplish the desired rapid progress about 500 men were employed, working day and night shifts; in addition, about 300 men were engaged after the fire to clean up and then increase the speed of construction. This work was carried on during the winter months, with temperatures ranging as low as 38 deg. below zero.

Assembling Heavy Hydraulic Units in Plant at Bombay

Rotors and Runners of Six 10,000-kva. Generating Units Shrunk on Shafts with Aid of Only Native Labor

FOR THE installation of machinery in the hydro-electric plant of the Andhra Valley Supply Co. near Bombay, India, only native labor, mainly unskilled, was available and it was deemed expedient to use the shrink-fit method of attaching generator rotors and hydraulic runners to the shaft. The plant is equipped with a traveling crane of capacity sufficient to handle the complete rotating elements of each unit. There are six units, each with a capacity of 10,000 kva. and each driven by a single overhung impulse runner.

The assembly of each unit required that five parts be attached to the shaft, four rotor spiders for the generator and one waterwheel runner. The shaft weighed 9 tons, the four rotor spiders 8 tons each and the waterwheel runner 12 tons, a total of 53 tons. The bore

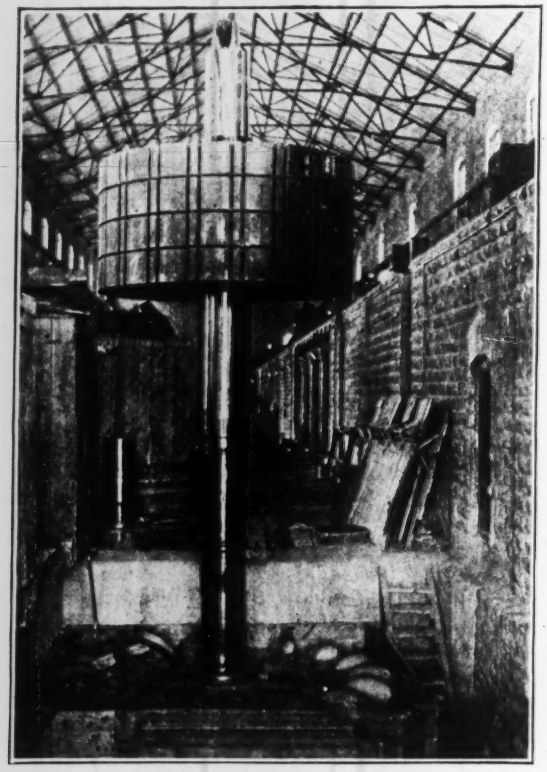


FIG. 1—SHAFT AND ROTOR BEING LOWERED INTO HEATED RUNNER

of runner and spider hubs was 0.003 in. smaller than the 22-in. shaft, and the plan of assembly was to expand the hubs by heat and insert the shaft cold.

A "steam box" large enough for one of the rotor spiders laid in a horizontal frame was constructed and a spider was lowered into it. Steam was then supplied by a 1-in. pipe from a donkey boiler outside the building. Four or five hours were required to increase the diameter of the bore 0.015 in., which made it 0.012 in. more than the shaft diameter.

The first spider to be applied in each unit was necessarily the one next to the outboard bearing on the generator end of the shaft; hence, in picking up the shaft for insertion it was necessary to grip it by a friction clamp over the journal itself as there was no

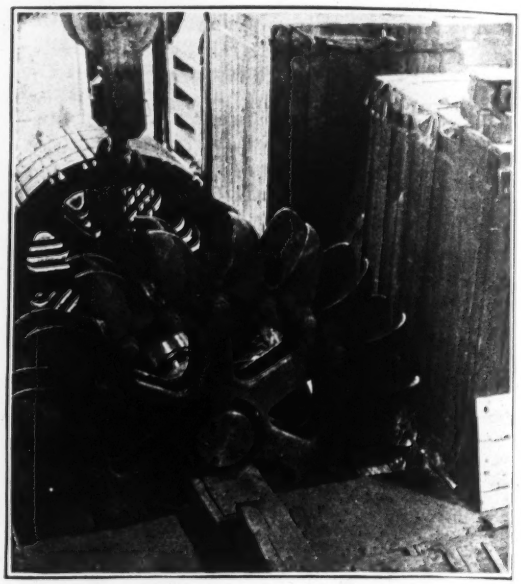


FIG. 2—STEP USED IN LOWERING UNIT TO HORIZONTAL POSITION

collar to keep the clamp from slipping off. The clamp used consisted of two 12 x 12-in. teak timbers fitted to the curvature of the journal and held together by two pieces of 12-in. I-beam 3 ft. long with three 1¼-in. bolts on each end.

At the conclusion of the required steaming period the steam was shut off and the box opened. The bore was then wiped out and its diameter checked before inserting the shaft, which went in easily. For the first spider on each shaft a stop was attached to prevent the shaft going too far; the spiders added later stopped against those already in place. After the first spider had shrunk in place the lifting clamp was removed and subsequent hoisting was done with slings attached to the first spider.

To insure alignment of the pole slots in the generator spiders, a long key with one end tapered was made to fit the slot exactly, and as each pair of spiders came together it was inserted and left in place until the last spider to be added had cooled and gripped the shaft. The time of cooling was prolonged as much as possible, twelve hours being usually allowed although the hub commenced to grip the shaft after one hour.

Aside from the cleaning and preparation of hubs and shaft (which would have been necessary regardless of method of assembly) the actual work for each hub required one man for eight hours to tend the boiler and crane, and four men for two hours to make the insertion and later to withdraw the assembly and place another spider in the box. The same procedure was followed for the turbine runner except that the requirements were for a slightly larger "steam box" and seven hours' steaming instead of five. In one instance all five hubs were set on a shaft in as many days.

When rotor and runner had been shrunk in place and the assembled unit was hanging from the crane

with the turbine runner down, an overhanging step was provided on one of the pit walls on which was rested the outer hub of the runner permitting the entire assembly to be lowered to a horizontal position without placing any weight on the buckets. The assembly was then picked up in a horizontal position and set in the bearing.

Installation was under the direction of C. V. Foulds, field engineer for the Pelton Water Wheel Co. by whom the hydraulic equipment was supplied.

The Engineer as an Expert Witness

Abstract of paper by Charles H. Young, consulting engineer, Muscatine, Ia., presented Jan. 30 to the Iowa Engineering Society.

AN ENGINEER'S services as an expert witness are valuable when a determination of facts depends on engineering knowledge. In rendering this service, the engineer should look ever to the viewpoint of rendering justice and maintaining the high standing of his profession.

The four divisions of service are as follows: Preparation; assistance to the attorney to ground facts; testimony on the stand; assistance to the attorney during the trial.

As the duties of the engineer are those of fact finding, he should confine himself to the particular case involved. If he is assisting in compiling the allegations, these should cover the basic points to be fought out in the trial. If the engineer is preparing the facts to combat the allegations, he must know what the allegations are before he can be qualified to present the proper facts to combat them.

It has been my experience that too often an attorney does not consult a reputable engineer when compiling the allegations, but uses a dragnet of supreme court decisions, expecting to catch the proper point by reason of these allegations. Very often the engineer is merely called to the stand to substantiate some engineering facts, although he has had no knowledge of what the allegations are and is ofttimes unqualified by reason of his experience in his particular line to give any more than hearsay testimony. The best attorneys, before any controversy is started involving engineering knowledge, are in the habit of engaging the services of a reputable engineer to assist them in the preparation of the allegations and of facts to substantiate the allegations.

In furnishing facts, a detailed explanation is inserted showing just why and how the facts were secured, from whom and where the information was received, and other data which might be pertinent in building a foundation for the case. If a statement of court dcisions is necessary to substantiate or combat the allegations notes of these cases should be thoroughly ferreted from the court decisions by a study of such cases and should appear in the data furnished. To be a successful expert witness, an engineer should be familiar with that phase of the law which pertains to the particular case involved and it is an advantage to the attorney if an engineering witness knows something of the law, as well as engineering, because of the connection of the engineering facts in the particular case involved with the legal requirements.

Following the printed analogy an appendix should be inserted, which should contain plats, profiles, tables, graphs and other information pertinent to the particular case involved. This appendix should be clearly explained in the report by reference. I have found that the coloring of plats in order to improve the conception by the court or jury as the case may be so that proper reference can be made, has proved invaluable in clarifying the facts in court, thus making them readily understood by the non-technical observer. Likewise, the simplification of engineering terms into language which can be clearly understood by the court is an advantage and can be cultivated by experience of the witness.

In placing himself upon the witness stand the engineer should take his oath as required and register with the clerk of the court in order that his presence in court may be recorded and his fees listed. As the fees allowed by the state law would be insufficient to encourage any engineer to fit himself to be an expert witness prior arrangement should be made with his client concerning compensation beyond that allowed by the court.

When testifying on the witness stand the control of temper is important; one cannot think clearly when his temper is aroused. There is no reason for anger on the part of the witness for the attorney is merely attempting to extract the facts in order that a proper knowledge of the questions involved may be had by the court. If the attorney resorts to ridicule, flattery, praise, intimidation, inflection of voice and leading questions, he is merely using these tools of his profession in a just and logical manner. The best attorneys in this day do not resort to these tactics, for they are merely trying to determine whether or not the witness is qualified to give testimony on the particular question involved.

During the trial and during the cross-examination of technical witnesses on the opposing side a witness can be of great value to his attorney by assisting in compiling the questions to be asked. For this purpose I use a 3 x 5-in. index card and record the answers of the opposing witnesses and then supply propounded questions for the attorney to draw out contrary testimony which may be instrumental in establishing the facts.

Rainfall Cycles and New Periodicity Test

WHAT is said to be the longest existing continuous rainfall record, that of Padua, Italy, has been studied by Robert E. Horton, Albany, N. Y., for evidences of periodicity or cyclic character of rainfall. Counts of the number of groups consisting of, respectively, two, three, four, etc., years above or below the mean, and comparison of these counts with the number of such groups which would occur under pure chance distribution showed a slight excess in number of groups for a six-year group in the Padua record. This evidence of periodicity was considered too slight to be significant. A new test for periodicity was then applied by Mr. Horton. This test is the following:

The total number of groups of consecutive years above or below normal, irrespective of length of group, is counted; denoting this number by G, and the total number of entries in the record by m, the quotient m/G gives the average number of years in a group. It is known from the theory of statistics that for purely chance distribution this number should be 2. Dividing the average group length by 2 will then express the ratio in which the phenomenon in question departs from pure chance occurrence. When the ratio is near 1, it indicates chance distribution, with a high degree of probability. For a periodic phenomenon, free from all chance variation, the ratio will be one-fourth the length of the cycle. For the Padua record the ratio is 1.16 and for five other precipitation records (Havana, New Bedford, Cincinnati, Albany, San Diego) it is 1.22, 1.28, 1.05, 1.54, 0.97. The highest value, that for Albany, is mainly due to the inclusion of a 17-year group of low years in the record.

None of these figures are considered to depart sufficiently from 1 to warrant a conclusion as to cyclic rainfall. This becomes evident by comparison with the same criterion computed for a phenomenon having a well-defined cycle, such as sunspot frequency. For this the value of the criterion is 2.5, whereas one-fourth the average sunspot cycle is 2.85. The criterion fails for a cyclic period of four years, or any period approaching this, since the ratio 1.0 will result for a perfectly cyclic event of four years' period just as truly as for chance occurrence. (Abstracted from *Monthly Weather Review*, October, 1923.)

Precise Triangulation and Level Nets of the United States

Growth of Geodetic Survey Network During Past Century—Present Extent of Surveys—To Be Extended Throughout Country

By William Bowie
Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

As a result of greatly increased demands for accurate surveys and maps during the past twenty years, much greater progress is now being made in the extension of the vertical and horizontal control systems, the precise-level and triangulation systems of the United States.

The horizontal control for the charts along the coast of the United States was completed by the U. S. Coast and Geodetic Survey a number of years ago. This control, although only secondary in character, was strengthened by two arcs of precise triangulation, one extending from eastern Maine to the vicinity of Mobile, Ala., and the other along the entire Pacific coast of the country. In 1871, an arc of precise triangulation was begun to connect the charts of the east and west coasts. This work was found to be of such value in the surveying and mapping of the interior of the country that a plan was adopted to carry similar precise horizontal control over the whole interior of the country to such an extent that eventually no place in the United States would be farther than about 50 miles from a triangulation station.

Systematic precise-leveling was begun by the several river commissions, under the Corps of Engineers, U. S. Army, and by the U. S. Lake Survey, either for the purpose of vertical control for maps or in connection with river improvements and protection from floods. The first leveling done by the Coast and Geodetic Survey was only incident to its precise triangulation; it was necessary to know the elevations of the base lines of this triangulation in order to reduce their lengths to sea level. It is evident that if one base is measured on a high plateau and another is measured in a valley, such as that of the Mississippi River, the length of one base as measured and as computed through the triangulation from the other base will not agree. The lengths of the triangulation net are, in consequence, based on the lengths of the base lines as they would be at sea level, and this requires knowledge of the elevations of all survey points. But from the work of extending lines of precise leveling over the country for the control of elevations in triangulation it was a simple step to run other lines of leveling for surveying, mapping and other purposes.

The progress made in the extension of the triangulation and leveling nets to specified years is shown below:

To	Precise Triangulation Arcs and Traverse Lines Miles	Precise Leveling Lines Miles
1900	7,000	15,000
1912	12,000	29,000
1923	20,000	47,000

The Coast and Geodetic Survey is the only organization now engaged in precise control work. It has done 18,000 miles of the precise horizontal control and 30,000 miles of the precise leveling. The other 2,000 miles of horizontal control was done by the U. S. Lake Survey, while the other 17,000 miles of precise leveling was done by or under the direction of the Corps of Engineers, the U. S. Geological Survey, and several railroads (Pennsylvania, Baltimore & Ohio, and Buffalo, Rochester & Pittsburgh).

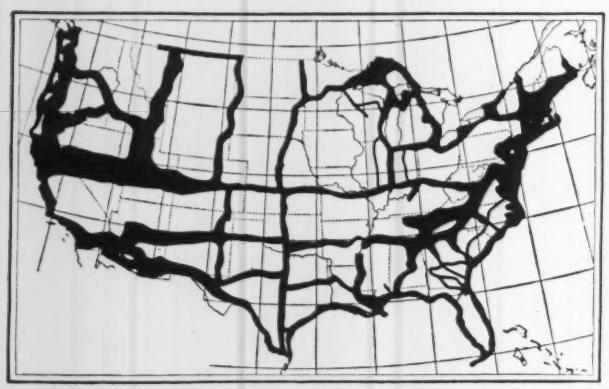


FIG. 1—PRECISE TRIANGULATION COMPLETED TO 1924

FIG. 2—NETWORK OF PRECISE LEVELS

The two accompanying illustrations show graphically the present status of the control systems and the location of the lines of leveling and the arcs of triangulation and lines of traverse.

Most of the data are now in print and the reports containing them may be purchased for a small sum from the Superintendent of Documents, Washington. There are more data available in the form of geographic positions and elevations of primary and secondary accuracy, but these cannot be considered as final until they have been properly tied into the precise nets. This tying in cannot be done (except for a few localities) until the fundamental nets have been further extended.

Much leveling and triangulation remains to be done to complete the precise nets, but the great demands made for this work will undoubtedly lead to a more rapid completion of these very essential and fundamental projects. The lack of precise control in certain large areas is now seriously handicapping the topographic mapping.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Geodetic-Topographic Survey of Richmond

REVIEWED BY HUGH C. MITCHELL

U. S. Coast and Geodetic Survey, Washington, D. C.

REPORT OF THE GEODETIC AND TOPOGRAPHIC SURVEY OF RICHMOND, VIRGINIA, as Executed in 1921-1922 by the E. H. Randall Co., Topographic Engineers, Under the Supervision of the Bureau of Surveys, G. M. Bowers, Chief of Bureau —Richmond, Va.: Department of Public Works, Allen J. Saville, Director. Paper; 6 x 9 in.; pp. 83; folding plate and pocket maps, other line cuts and halftones.

The report on the Richmond Geodetic-Topographic Survey is a most unusual one. When, in 1921, the city of Richmond made its final arrangements for securing a complete and comprehensive geodetic and topographic survey of its domain, it found itself almost a pioneer in a new field. There were already in existence the classic reports of the New York Board of Estimate and Apportionment on the triangulation and precise levels of that city, the report on the geodetic topographic survey of Cincinnati, data of the topographic surveys of Washington and of Baltimore, a few reports on base level surveys of various cities—and little else.

The Richmond report should therefore be of extreme interest to municipal engineers, adding as it does valuable data to a far too little list of reports on what is perhaps one of the most important branches of engineering in this country today—the making of precise physical surveys of a city's domain for the control of all cadastral work, of all planning work, and for use in a great deal of record work. This activity of cities is not wholly new but it is only now taking concrete form in actual surveys. With surveys already made of New York, Cincinnati, Richmond, Va., and Flint, Mich., as well as of a number of smaller cities, and with a precise survey started by Pittsburgh, city engineers may well ask themselves "Am I overlooking something?" If they will carefully read the Richmond report they may find an answer to their question.

One great value of such a report is the showing of why such a survey is needed, what mistakes of the past are to be avoided and why and how. No further amplification of this point may be required than to quote directly from the report itself (p. 5), where after giving a table showing the separate annexations of territory, nine in number, to the city over a period of 170 years, the chief of the bureau of survey states: "In almost every instance the area so annexed had been previously subdivided, with streets and alleys laid out and the lands sold off in lots to individuals without consideration of topography, drainage, continuation of existing thoroughfares or other physical data." The various reasons which led the Department of Public Works to undertake the survey of Richmond are carefully set forth by Mr. Bowers in the first part of the report, and the work justified by a summary of the results, supported by a table showing its moderate cost.

The second part of the report, by the engineers who actually made the survey, covers the execution of the triangulation, traverse, plane table mapping, and record work. Selecting several high points from this part of the report, the reviewer finds on p. 19 a table of comparisons of the triangulation results of several cities and hopes it may not be amiss to use it to point one lesson to the municipal engineer who may be considering the undertaking of such a survey. According to the context of the Richmond report, the two base lines of that survey were measured with a single steel tape, under apparently the same conditions and with practically the same personnel. The accord of base lines indicated, namely, 1 part in 43,000, may be somewhat misleading when considered in connection with the figures given for New York and Cincinnati. This accord undoubtedly shows that the accidental errors of measure were well controlled and reduced to a small quantity but from the data given in the report one cannot say that there are no significant systematic errors remaining undetected in the final results. This is not true in the case of the two other cities to which reference is made above. In the New York survey a number of steel tapes were used under varied conditions of measure which would preclude such a result, while on the Cincinnati survey several invar tapes were used, and the measured line was checked against one of the main lines of a major arc of triangulation of the federal survey, which in turn depended on two of the principal base lines of that arc, measured many years earlier and by entirely independent methods. If the municipal engineer finds it necessary to use steel tapes in his base line measures, he should use them with great caution. He should take means to discover any systematic errors and reduce them to an economical minimum. He may accomplish this by making measures only at night or on cloudy days, on days when the temperature is not changing rapidly, and by shifting the personnel, etc. He will find it far better and much simpler to provide base tapes of invar, which has a coefficient of expansion only about one-twenty-fifth as large as that of steel and can be used under practically any weather conditions.

On p. 19 of the Richmond report is given a method of obtaining data for reducing an eccentric set-up at a triangulation station. In many cases the obtaining of these data with the required degree of accuracy presents a most perplexing problem, and it is believed that the solution herein presented will prove most effective in all cases.

On p. 27 are given the specifications for the topographic survey. These specifications may be taken as standard for city topographic surveys. They show also that the essentials of such a survey can be reduced to standard specifications, and that the execution of such a survey may be handled as are many engineering projects —executed under contract. The city can fully determine what it requires in the way of a survey, can specify the details of accuracy and matter to be included in the sur-

vey, and can know truly if the specifications are being lived up to.

Whether or no he already has a survey of his city's domain, the municipal engineer should find the Richmond report of great interest and value, for no matter how complete a city map may be at the time it is made, it will soon be outgrown in many parts. Like the city plan which may be based on it, the city survey is never complete, but is ever changing and growing, and the Richmond report may well be taken as a guide in providing standards and methods both for securing a new survey of the city's territory and for keeping up to date a survey already made.

The thanks not only of the City of Richmond but also of all engineers who would follow the path pointed out are due Allen J. Saville, director of public works, through whose initiative the Richmond survey became a possibility, as well as to G. M. Bowers, chief of the bureau of surveys, and to the contracting engineers through whose efforts the survey became a reality.

The Realtors' Viewpoint

CITY GROWTH AND VALUES—By Stanley L. McMichael, Realtor, and Robert F. Bingham, Attorney-at-Law. Cleveland, Ohio: The Stanley McMichael Publishing Organization. Cloth; 6x9 in.; pp. 369; diagrams and many half tones. $5.

Many factors affecting city growth and real estate values are here presented from the viewpoint of the realtor. The data and deductions drawn may be considered as acceptable to realtors in general for the book carries the endorsement of the National Association of Real Estate Boards.

The scope of the book is broad, the data at least sufficient for the purpose and such conclusions as are drawn seem to be well considered, although naturally they reflect the realtor's view rather than that of the student of municipal affairs and the public interest. In many places there are more data or descriptive matter than deductions. Among the topics treated are: Types of Cities; Growth as Affected by Specialized Influences; Transportation Facilities; Streets and Highways; Trend of Pedestrian Traffic; a number of chapters on land and building values, including different classes of property; Restrictions; a series of chapters on land values, including a review of attempts to put valuation on a scientific basis; Income Analysis; City Planning and related matters; and How Large Should a City Be?

Altogether the book deserves commendation as a painstaking attempt to review the field indicated from the realtor's viewpoint—which as here presented coincides largely with that of the public interest. The book and its endorsement, already noted, are in keeping with much else that has been said and done by realtors in their recent co-operation in city planning and zoning work.

Thirteen Hundred and Fifty Fallacies

POPULAR FALLACIES EXPLAINED AND CORRECTED (with copious references to authorities)—By A. E. S. Ackermann, M.Assoc. Consulting Engineers, Assoc.M. Inst. C.E. [Third Edition.] London: The Old Westminster Press. Cloth; 6x8 in.; pp. 984.

For chance reading and for reference on occasion the new and greatly enlarged edition of Mr. Ackermann's Popular Fallacies deserves commendation. Under 24 heads—including, Astronomy, Biography, Engineering and Science, Literature, Law, Statistics and the Weather, the author has brought together explanations and corrections of 1,350 common fallacies. The fact that much of the material consists of quotations from various writers adds to the variety, interest and, since many of the authorities cited are specialists, to the soundness of the explanations. In some cases there are numerous citations and further references are under Divining Rod, which subject is given 6 pp. Engineering and Science has 80 pp. altogether. A detailed index is provided.

Stress Analysis in Trusses

STRESSES IN FRAMED STRUCTURES, Compiled by a Staff of Specialists—Editors-in-Chief: George A. Hool, Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 620; 485 line cuts. $5.

A worthy addition to the literature of framed structures is represented by the third volume of Hool & Kinne's ambitious six-volume series. There is no dearth of excellent texts and treatises on stress analysis of trusses, and the newcomer's place in practice must be won in competition with existing works of high merit. Its points of distinction are a condensed but unusually clear style and treatment, and a range of subjects well fitted to present-day needs.

Half a dozen authors collaborated in the writing of the book, and the different chapters show corresponding differences of individuality and practical view. However, the editors have very effectively welded the whole into a homogeneous structure.

Special attention is invited by the later chapters, following after the presentation of simple stress analysis in trusses under fixed and moving loads. These are concerned with deflection of trusses, statically indeterminate analysis, secondary stresses, rectangular frames, lateral strength of tier-building frames, and transmission tower analysis. Supplementing the section on frames is an appendix giving an elaborate series of tabulated formulas for moments in rectangular bents and frames under various conditions. To many these chapters will prove the most valuable part of the book.

On the score of its general character, Stresses in Framed Structures seems primarily a college textbook. It gives good promise, however, of also meeting the reference needs of the practicing engineer.

The City Government of Tokyo

THE ADMINISTRATION AND POLITICS OF TOKYO: A Survey and Opinions—By Charles A. Beard, formerly Director of the New York Bureau of Municipal Research. New York: The Macmillan Co. Cloth; 6x8 in.; pp. 187. $2.50.

The Japanese earthquake and fire of last September add both interest and value to Dr. Beard's critical analysis of the city government of Tokyo, which had been completed by him before the catastrophe occurred. The study is based on personal investigation, made in Tokyo by Dr. Beard at the request of the Tokyo Institute for Municipal Research through Baron (now Viscount) Goto, then mayor of Tokyo and subsequently Minister of Home Affairs for Japan.

After a chapter on The Criteria and Scheme of Municipal Science, the author reviews Tokyo conditions as regards the area and government of the city, its financial management, city purchasing, personnel administration and municipal utilities. The book closes with chapters on The Spirit and Practice of Self-Government in Tokyo

and a Work Program for the Government and Citizens of Tokyo. Much of this program relates to paving, street cleaning, sewerage, transportation, and traffic regulation. Sewerage and paving in Tokyo are chiefly notable by their absence. Of pavements Dr. Beard says, in part:

> Taking the Imperial, prefectural, and municipal roads one ken or more in width, there were on Dec. 31, 1921, 613.2 miles. * * * * Of this mileage 4.3 miles are now paved, 2.8 miles mainly with wooden blocks and 1.5 miles with asphalt or concrete. On rainy days the unpaved streets swim in thin mud, which is sometimes ankle deep. * * * * In bad weather the whole life of the city, business and social, is slowed down by mere mud. In dry weather the streets are deserts of dust or lines of mud puddles made by careless sprinkling.

The book will doubtless be of great value not only in Tokyo but throughout Japan. It should command the attention of all students of municipal government.

Movable and Long-Span Bridges

REVIEWED BY LEON S. MOISSEIFF
Consulting Engineer, Engineer of Design, Delaware River Bridge, Philadelphia, Pa.

MOVABLE AND LONG-SPAN STEEL BRIDGES—Compiled by a Staff of Specialists: Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; many halftones and line cuts. $5.

The lot of the reviewer has been made more difficult by the publication of books which are the result of the co-operative efforts of a group of specialists selected by editors-in-chief. Homogeneous as the work may be made to appear at the first sight, it will disclose to the careful reader the construction joints of the parts and the unequal quality of the material. There may be more stability in a group of minds than in one, but there is at times, in the entire work, a lack of logical coherence of unified thought. And to a large extent logic is a form of self-criticism. The book, Movable and Long-Span Steel Bridges, shares in the merits and defects of all such co-operative products.

To movable bridges nearly 200 pp. or 40 per cent of the book are devoted. On three-quarters of these pages P. A. Franklin and C. B. McCullough treat of bascule bridges. Mr. Franklin discusses the planning and design of the superstructure, the live- and dead-load stresses, counterweights and their treatment and the foundation requirements peculiar to this type of bridge. He also gives the "complete structural design of a double-leaf simple trunnion deck bascule highway bridge." Beginning with the governing dimensions, specifications are established for loads and stresses and the computations and designs of the floor system, the determination of the stresses and the make-up of the truss members are given in full. Counterweight computations and methods of balancing the span are carried through in detail. Mr. McCullough presents in a systematic and complete manner the design of the operating machinery. Thus the bascule type of movable bridge receives a thorough treatment the like of which has not been available heretofore. It is excellent information presented in a lucid manner and will serve as a guide to the bridge engineer.

Vertical lift bridges are discussed in a more general way in some 20 pp. by H. E. Pulver, and in equal space C. A. Ellis gives an example of the computation of the stresses in a center-bearing swing bridge of 300-ft. span. The disproportion of the space devoted to the bascule type is an indication of its well-deserved popularity. The bascule is a good bridge and overcomes many difficulties in crowded cities and over busy rivers. The meagre space allotted to the swing bridge by the editors is, however, not justified. The swing bridge is a reliable and efficient structure which has proven its worth for many years and will be found most suitable in many places. It deserved a fuller treatment in a handbook like the present volume.

The remaining six-tenths of the book are devoted to long-span bridges, comprising continuous, cantilever, suspension and arch bridges. D. B. Steinman treats continuous bridges. These bridges are but recent arrivals in American bridge building. Inspired by the fine examples of the Sciotoville, the Bessemer and Lake Erie, the Nelson River and the C. N. O at Cincinnati, the author enthusiastically preaches the sermon of the continuous truss with the zeal of a neophyte. A. G. Hayden in some 30 pp. treats cantilever bridges. He brings a clear statement of the characteristics and variations of this type and discusses the determination of the stresses in the simpler trusses. Some erection details and anchorages are illustrated by examples from prominent American bridges.

Suspension bridges receive considerable attention. In about 70 pp. D. B. Steinman gives a condensed treatise on this type of structure, differing so much from truss bridges. The recent tendency in long-span bridges has been towards the suspension bridge and any additional information on the subject is timely. This part of the book is a condensed abstract of Mr. Steinman's interesting book on Suspension Bridges, and will serve well to acquaint the reader with the simpler problems and methods encountered in the design and erection of such bridges. The author adheres to the elastic theory, which neglects the deformations of the cable and does not mention the deflection theory which takes these deformations into account. The deflection theory is not only much nearer the truth but it also results in stiffening trusses frequently requiring 20 to 25 per cent less material. The use of the elastic theory is therefore antiquated and wrong except for relatively stiff bridges. It is excessive even for purposes of estimate.

Considerable space is justly allotted to arch bridges of the several types. The entire subject is treated by C. B. McCullough in 110 pp. He gives the simple analysis of the stresses in a three-hinged trussed arch and then proceeds to develop the general elastic equations for arch frames based on the principle of work. An exhaustive presentation of the analyses of fixed arched trusses as well as that of solid ribs is given and illustrated by numerical applications to spans of 275 ft. and 350 ft. Interesting and useful as this information on the analysis of arches will prove, the total absence of any data on and illustrations of existing arches is sorely noticeable. Nor are the practical aspects of arch bridges taken up.

Considering the book as a whole there is no inherent reason why the movable bridges could not well be separated from the long-span bridges. In character their treatment is fundamentally different and they should be approached from different engineering viewpoints. Their meeting in one book is accidental.

The book presents a serious attempt to supply much

material on movable and long-span bridges in the form of an engineering handbook and will be found to be useful to the bridge engineer. Its diagrams and other illustrations are very fine.

Early Egyptian Engineering

THE PROBLEM OF THE OBELISKS: From a Study of the Unfinished Obelisk at Aswan—By R. Engelbach, Chief Inspector of Antiquities, Upper Egypt; author of "The Aswan Obelisk," etc. New York: George H. Doran Co. Cloth; 6x9 in.; pp. 134; 44 figures in text and on halftone plates. $4 net.

In these days of Tutankhamûn (the spelling is Mr. Engelbach's and therefore authoritative) every reader of the newspapers knows something about Pharaohic Egypt, though the recent excavations have diverted attention to Egyptian early art from the once popular conjectures regarding pyramids and obelisks. Engineers, however, still continue to wonder about the methods and practices of this early civilization which was able to build monuments of such size as to challenge the ingenuity of modern engineering science. For the engineer, then, Mr. Engelbach's book has an interest greater than the current dispatches from Luxor.

How did the ancient Egyptians, unacquainted with practically all mechanical devices and unprovided with iron or steel and possibly with tempered copper, though this latter is doubtful, contrive to cut out of a solid bed of granite a huge monolith 137 ft. long, nearly 15 ft. square at the base and 8 ft. square at the top and weighing 1,168 tons? This is the question Mr. Engelbach sets out to answer; and he answers, too, how this block of stone was moved many miles and set up in place. His theories are very ingenious and backed by evidence that an engineer will appreciate, if not as conclusive, certainly as preponderating. It is sufficient to note that the quarrying was done mostly with hard stone balls dropped repeatedly to form a channel, with the possible use of tempered copper chisels and the certain use of fire as a stone softener, and that the problem of erection was solved by the use of a gigantic sand jack similar to those used in much smaller scale in striking arch centers.

Of current interest to readers of *Engineering News-Record* may be noted the fact that there was in those days a guild of "obelisk engineers," who left inscription records of their achievements. One of these early professionals left this modest tribute to himself: "I became great beyond words . . . My years were spent in gladness. I was neither a traitor nor a sneak, and I did no wrong whatever. I was foreman of the foremen, and did not fail . . . I never hesitated, but always obeyed superior orders . . . and I never blasphemed sacred things." Altogether a model engineer.

Concrete Design for Students

DESIGN OF CONCRETE STRUCTURES—By Leonard C. Urquhart, Assistant Professor in Charge of Structural Engineering, Cornell University, and Charles E. O'Rourke, Assistant Professor of Structural Engineering, Cornell University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 452; 166 line cuts. $4.

There is great difference between the requirements of a reference book on concrete and a textbook for students. Most of the books lean more to the former than the latter so that the student, approaching the subject for the first time, is forced to wade through a great deal of purely reference material and a great deal more which is controversial and, it has turned out often in concrete matter, of only transient importance. Professors Urquhart and O'Rourke have the student primarily in mind and their book benefits thereby in its textbook qualities. As a reference, it is somewhat categorial and elementary but that is no adverse criticism, for it is not intended for reference. Indeed, there are quite enough reference books on concrete and a new one is not needed.

The Stephensons and the Locomotive

A CENTURY OF LOCOMOTIVE BUILDING BY ROBERT STEPHENSON & CO., 1823-1923—by J. G. H. Warren. Newcastle-upon-Tyne, England: Andrew Reid & Co. Cloth; 8x11 in.; pp. 461; freely illustrated with reproductions of paintings, engravings and line drawings. 28s.

No record of locomotive building in Great Britain during the past century would be complete unless it contained much of the life history of the two Stephensons, George (1781-1848) and Robert the son (1803-1859), and of the history of their successors, the directors of the firm of Robert Stephenson & Co. "A Century of Locomotive Building," written by J. G. H. Warren, is the result of the natural desire of the present directors to see put into permanent form, the part played by the two Stephensons and their successors. They may well be proud of it. To anyone interested in the early history of locomotives and railroading the book will have a strong appeal, especially as the author has supplied that feature which is so often lacking in such a record, the source of his subject matter, giving copies of the old drawings, plans, and extracts from old papers, all carefully referenced. The reproductions of old cuts and drawings are, of themselves, of great historical value.

The greater part of the book is given over to detailed descriptions of many of the locomotives built when the art was new, and of the first railroads of England. The latter part of the book describes some of the later types of locomotives, the famous Stephenson link motion, the gage experiments, the later developments of Robert Stephenson & Co., and modern British locomotives. There are also chapters of biographical matter concerning the Stephensons and other men intimately connected with the development of Robert Stephenson & Company.

As a history of a century of locomotive building the book will be disappointing to readers on this continent because nothing is said about locomotive developments in America other than in the days when Robert Stephenson was supplying locomotives for our early railroads. This, however, does not detract from the value of the book within the field that it surveys.

The Atom Today

THE A B C OF ATOMS—By Bertrand Russell, F.R.S. New York: E. P. Dutton & Co. Cloth; 6 x 8 in.; pp. 162; diagrams. $2.

With no mathematics beyond simple algebra, and that almost all in a 4-p. appendix, one of the most brilliant writers and scientists of England here pictures the atom in the light of the knowledge and theory of today. Some idea of the scope of the book may be gained from a few of the chapter headings: Electrons and Nuclei; Hydrogen Spectrum; Rings of Electrons; X-Rays; The New Physics and Electricity. The book should appeal to the engineer and others who were taught that the atom is an "indestructible unit of matter," but who for whatever reason have not kept up with the subsequent advances in chemistry and physics.

Scientist, City Planner and Great Architect

SIR CHRISTOPHER WREN: Scientist, Scholar and Architect—By Sir Lawrence Weaver, K.B.E., F.S.A., Hon. A.R.I.B.A. London: *Country Life* and George Newnes. New York: Charles Scribner's Sons. Boards and cloth; 5x8 in.; pp. 173; 16 half-tone plates and 16 figures (mostly pen sketches) in the text. $2.75.

The Great Fire of London in 1666 brought Wren to the front with his notable plan for rebuilding the city. The plan was rejected, as have been most other grand conceptions to rebuild destroyed cities, through the small mindedness of landowners who insisted on retaining their original holdings and building on them as they chose. But although Wren did not rebuild London to a well-ordered plan, he did reconstruct St. Paul's Cathedral and some fifty parish churches, thus establishing his fame for centuries. During a half century he was surveyor general of the King's works. Before the great fire Wren had won recognition as an inventor and scientist, and helped found the Royal Society. All these and other incidents in the life of this great architect and builder are outlined in this sympathetically critical sketch of Wren's life—the Preface to which was written on the two-hundredth anniversary of Wren's death.

PUBLICATIONS RECEIVED

A JOURNAL OF MATERIAL AND TESTS, a new element of current engineering literature, makes its bow to the public under the title of *Testing*, a monthly issued under the imprint of the Pullman Publishing Co. of New York (Pullman Building) and the editorship of Charles Osgood Reid. The field of material and tests, to which the new journal is devoted, has heretofore lacked a specialized organ in the English language. A number of years ago *Baumaterialienkunde*, published in Vienna, endeavored to represent this field, as the mouthpiece of the International Association for Testing Materials, an organization which disappeared in the world's recent shifting of scenes. The importance of materials and their investigation as subjects of technical study has grown greatly in the last decade or two, and promises to grow much more; out of this condition, no doubt, the new magazine has sprung. Its subtitle, "An International Monthly," reflects an ambitious ideal. The future must tell how far this ideal can be transformed into fact in the present disturbed era. What field the editor has outlined for *Testing* may be judged from the table of contents of the first (January) number: The Importance of Special Alloy Steels in Industry, Sir Robert A. Hadfield; A letter from J. A. Brinell; Science Should Know No Nationality, John M. Lessells; Testing Wires and Wire Ropes, with Special Reference to Fatigue, R. G. Batson; On Notched-Bar Impact Tests, P. Fillunger; Researches on the Duraluminum Problem, W. Fraenkel and E. Scheuer; Calibration of Small Compression Testing Machines, Herman A. Holz; An Improved Type of Microscope for Measuring the Impressions Produced in the Ball Hardness (Brinell) Test, O. C. Rudolph; Determination of the Carbon Content of Steels, Russell J. Eddy; Investigation of Lubricating Oils and Bearing Alloys, R. v. Dallwitz-Wegner; A Universal Static and Kinetic Wood Testing Machine, B. C. Anderson; and The Strainviewer, a Polariscope for the Routine Inspection of Hollow Glassware and of Other Glass Articles for Strains, William Porter.

RECENT CITY PLANNING REPORTS include Waterways a Part of the Pittsburgh Plan (Report No. 6, Citizen's Committee on City Plan of Pittsburgh; 50c.) and the Cranston Zone Plan, by Robert Whitten, city planning and zoning consultant, and Charles F. Fisher, associate, of Cleveland, Ohio, and Providence, R. I. The last-named pamphlet outlines the zoning ordinance passed by the city council of Cranston, R. I., Jan. 18, 1924. Mr. Whitten is also consultant to the Pittsburgh Committee, of which Winters Haydock is chief engineer.

A VAST ARRAY OF FIGURES is given in the 1425-p. volume of Commercial Statistics, 1922, compiled by the Statistical Division, Board of Engineers for Rivers and Harbors, as a part of the 1922-23 report of the Chief of Engineers, U. S. A. After a brief summary the freight traffic for various rivers and ports in the United States is given by classes of material.

PAPERS ON HEALTH TOPICS which appeared in various publications in 1922 make up the third volume of Contributions from the Department of Public Health, Yale University School of Medicine (New Haven, Conn.). The volume contains several papers by Prof. C.-E. A. Winslow written singly and in collaboration, among which European Hea.th Conditions and Efficiency of Various Kinds of Ventilating Ducts may be mentioned.

FOUR YEARS' WORK by the New York State Conservation Commission (Albany) is summarized in a 50-p. Report on Investigation of the Pollution of Streams, for which $38,000 was available. The nature and extent of the problem and possible means of control are reviewed. Creation of a Conservancy Commission is proposed. Russell Suter is senior engineer and William Firth Wells is biologist and sanitarian of the commission.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

DAMP WALLS: A Handbook on the Various Causes of Dampness in House Walls and the best Methods for Architects, Builders, Surveyors and Property Owners in dealing with this troublesome Defect; With a chapter on Condensation and Notes on Waterproof Building Construction—By Ernest G. Blake, M.R.S.I., A.B.I.C.C., Medallist in Sanitary Building Construction; Author of "Building Repairs." New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 248; 68 halftones and line cuts. $3.

FEDERAL INCOME TAXES, PRINCIPLES AND PRACTICE—By E. E. Rossmore, B.S., Certified Public Accountant, New York; Sometime Chief of Special Audit Section, Chief of Consolidated Returns Section, and Lecturer on Income and Profits Taxes in Bureau of Internal Revenue, U. S. Treasury Department; Author of "Federal Corporate Income Taxes" and "Federal Income Tax Problems—1922." New York and London: D. Appleton & Co. Cloth; 6x9 in.; pp. 864. $6.

After 114 pages devoted to principles, the author makes use of the case method of treatment. He presents and gives solutions of 467 problems which, he says, are likely to arise in the preparation of the income tax statement of any individual, partnership, or corporation.

THE LIFE OF SIR WILLIAM WHITE, K.C.B., F.R.S., LL.D., D.Sc.—By Frederic Manning. With an Introduction by the Rt. Hon. Lord George Hamilton. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 502; frontispiece portrait and 12 diagrams. $8.

THE PERSONAL RELATION IN INDUSTRY—By John D. Rockefeller, Jr. New York: Boni & Liveright. Cloth; 6x8 in.; pp. 149. $1.75.

PRACTICAL ACCOUNTING AND COST KEEPING FOR CONTRACTORS: Illustrating and Describing in Easy, Understandable Language, Bookkeeping and Accounting Systems for Contractors, Giving Complete Instructions and Examples of the Proper Methods of Keeping Time and Compiling Costs on all Classes of Construction Work—By Frank R. Walker, Affil.Am. Soc.C.E., Author of The Building Estimator's Book. Chicago: Frank R. Walker Company. Cloth; 9x12 in.; pp. 169; 245 reproductions of forms. $2.50.

THE PRINCIPLES OF VITAL STATISTICS—By I. S. Falk, Ph.D., Department of Public Health, Yale University. Philadelphia and London: W. B. Saunders & Co. Cloth; 5x8 in.; pp. 258; 30 figures in the text. $2.50 net.

An elementary survey, free from technicalities and with no mathematics except simple arithmetic; well provided with illustrative statistics and diagrams; readable and suggestive. Based on lectures to public health nurses but suitable for self instruction by health officers in small places or anyone who wishes to get a general working knowledge of the subject without going into the details afforded by Prof. George C. Whipple's Vital Statistics, the first and second editions of which were noted in these columns June 19, 1919, p. 1216, and March 15, 1923, p. 502.

RURAL HIGHWAY PAVEMENTS, Maintenance and Reconstruction: A Discussion of General Principles Illustrated by Current and Recommended Practice—By Wilson G. Harger, C. E., Engineer New York State Department of Highways; Former Senior Highway Engineer, U. S. Office of Roads; Author, Highway Engineer's Handbook, etc. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 637; more than 200 halr tones and line cuts, including folding maps. $6.

STEEL AND TIMBER STRUCTURES—Compiled by a Staff of Specialists; Editors-in-Chief: George A. Hool, S. B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x10 in.; pp. 605; many diagrams, charts and halftones. $6.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Another View

Sir—Many civilian engineers who were temporarily in the Corps of Engineers during the war will resent your attempts to separate the corps from participation in the nation's public works.

You, of course, recognize the fundamental advantage of applying the talents of the army engineer to such work in peace times, in the interest of economy and for the benefit of the corps. But your suggestion that he could find his place in the Department of Public Works, "rising with his civilian associates," is weak; for one reason, because it would mean serving two departments of the government at the same time. The soldier, of all men, must have undivided responsibility.

The field of activity of the army engineer is certainly as wide as that of the average civilian engineer. But if you sincerely "would like to see him more a part of the profession" why do you advocate a change that would inevitably narrow his field?

The injustice of limited possibility of advancement for the civilians in the Engineer Department can be remedied without taking civilian work from the department.

All engineers interested in preparedness—a word which unfortunately is not yet obsolete—desire closer relations between the military and civilian members of the profession, and they have a live organization, the Society of American Military Engineers, of which one of the principal aims is to promote such acquaintance and understanding, for they have learned the value of them in war. To deny to the army engineer a part in civilian work would be a step backwards.

It is entirely proper for you to point out the faults of the Engineer Department and if I know anything about its personnel they welcome just criticism. But do not fail to remember that the Corps of Engineers has been since the nation's beginning, a splendid organization. Let us be very careful to do nothing that will injure it, for some day we are going to need it badly. F. W. HENRICI.

Assistant Engineer, American Bridge Co.

Pittsburgh, Pa., Feb. 4, 1924.

Flexure of Buildings In Earthquakes

Sir—The writer has read with much interest the conclusions of R. F. Moss (see *Engineering News-Record*, Dec. 27, 1923, p. 1051) as to the lessons to be learned from the Japanese earthquake, touching upon the design of buildings for earthquake territories.

An examination of quite a few buildings subjected to mild earthquake shock has convinced the writer that, particularly in buildings of considerable height, the building does not move with the earth in case of horizontal earth vibrations, but, on the contrary, the inertia of the upper portion of the building holds it particularly fixed in position, while the lower portion of the building is vibrated laterally by the vibration of the earth. As a consequence of these examinations, the writer came to the conclusion that the safety of a building of considerable height, say 12 stories or more, and of relatively narrow base, is dependent more on the joint between columns and beams than on the walls.

In the buildings examined, practically every narrow building of 12 stories in height showed cracks in the upper part of the first story or in the mezzanine or second story. No signs of hair cracks could be found above these points, but every building showed signs in this region, and where walls were damaged the damage always occurred in this same place.

If this analysis of the situation is correct, it would not support the conclusions of Mr. Moss. On the contrary, it would seem to dictate a proper design of column and beam and much more than the usual attention to the strength of the joint between the two.

In other words, it would seem that an ordinary reinforced-concrete building, consisting of columns and beams and girders, filled in between with either slab construction or joist construction, would stand mild earthquakes readily if the joints between the columns and the girders were such as to compel both columns and girders to deflect simultaneously, thus permitting the foundation to vibrate with the earth, while the upper portion of the building, due to its inertia and the relatively short time of each vibration, would stay practically stationary.

Without doubt, low buildings, or possibly taller buildings of relatively broad base, can be designed with walls sufficiently strong to make the entire building travel with the earth in a mild earthquake, but a 12-story building of narrow base can hardly be made to travel with the earth throughout its entire volume; it will either rock and so allow its center of gravity to remain approximately stationary, or it will deflect in the neighborhood of the second floor and so allow the upper portion of the building to remain stationary, usually the latter.

The deductions to be made from this analysis of the effect of light quakes would be that, at least for tall buildings with narrow base, the walls should be relatively weak, so as to shear, and the columns and girders should be flexible with extra strong connections to develop this flexure and so allow the foundation to vibrate while the top remains stationary, without excessive damage to the building.

E. M. SCOFIELD,
Scofield Engineering-Construction Co.

Los Angeles, Calif., Jan. 14, 1924.

Detours an Item of Highway Cost

Sir—The article by Prof. T. R. Agg in *Engineering News-Record*, Jan. 10, 1924, p. 54, entitled the "Theory and Calculation of Highway Transportation Cost," is certainly deserving of the highest commendation from highway engineers. The method of analysis outlined and the data furnished are such that no engineer should be at a loss to give sound economic reasons for the selection of a certain type of pavement.

However, it is certainly regrettable that no mention is made of an item that, in the opinion of the writer, should enter into the analysis of the total annual cost of highway transport, although reference is made by the author to other variable items that were not included. I refer to the cost of detours. In the great majority of highway construction operations the section under construction is closed to traffic which is forced to operate over a route of greater length and of a low type of surfacing. The cost of constructing and maintaining detours and the extra cost of operating vehicles over them during construction or reconstruction, when reduced to an annual basis, constitutes a major charge in determining the total annual cost of transportation over pavements of various types. It has occurred to the writer that a formula for obtaining the annual cost of detour could be developed. It would be in terms of the extra length of detour, type of surfacing, estimated period of time and volume and character of traffic.

G. F. SCHLESINGER,
State Highway Engineer.

Columbus, Ohio, Jan. 28, 1924.

Record Roadbuilding

Sir—In your issue of Jan. 10, 1924, an editorial commenting upon the road construction in Illinois during 1923, makes the statement: "Its division of highways constructed last year 1,024 miles of paved road, several hundred more miles than any other state has ever completed in a single construction season."

Permit me to call your attention to the fact that during the time the writer was director of highways in the state of Ohio, during the year 1921, there was constructed 1,025.8 miles of improved roadway, practically all of which was hard surface road and none lower than standard bituminous macadam.

It is a matter of little consequence who receives the credit for road construction when a mileage of this amount can be built. It is a matter of great consequence to the traveling public and the taxpayers of the state that the hands of the politicians be kept off, or, rather, that politics be eliminated, so that the records may be continued.

Columbus, Ohio, Jan. 24, 1924. LEON C. HERRICK,
Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Building Officials Conference will hold its tenth annual meeting April 7 to 11 at Louisville, Ky. Rudolph P. Miller, 25 West 45th St., New York City, is in charge of arrangements for papers, and Jeremiah F. Downey, Cambridge, Mass., is secretary.

A Progress Report from the Moffat tunnel states that work is progressing well in spite of severe winter conditions, that there are now 175 men at work on each portal, and that there will be 225 as soon as more machinery arrives.

Two New Electric Power Plants will be built in the Carolinas by the J. B. Duke interests according to press reports. One will be a steam plant at Duncan, S. C., near Spartanburg, and one will be a hydro-electric plant at Hickory, N. C. Both will have an output of approximately 40,000 hp.

No Action on the Proposed standard specifications for excavation was taken at the recent annual meeting of the Levee and Drainage Contractors Association, held at St. Louis on Jan. 16 and 17, in connection with the National Drainage Congress. R. H. McWilliams, Memphis, Tenn., was re-elected president; secretary, C. S. Gannon, St. Louis, Mo.

Contract for the Construction of Section 8 of the Welland Canal, has been awarded by the Dominion government to A. W. Robertson, Ltd., of Montreal, at $10,528,215. It is understood that the company will commence excavation work on a large scale in the spring, which will make necessary the destruction of a large part of the business section of Port Colborne, Ont.

Plans for the Electrification of all railroads entering Boston were submitted to the Public Utility Commission at a hearing held recently on the petition of the United Improvement Association that the Department of Public Utilities order the steam railroads to electrify their lines within the metropolitan district. The estimated cost of the electrification is between $40,000,000 and $50,000,000.

In the Opinion of Commerce Secretary Hoover, no executive order transferring the Bureau of Mines, or any other technical bureau, to his department will be issued pending the report of the joint committee on reorganization. The committee is awaiting the printing of the hearings before attempting to discuss recommendations. Senator Harrison, one of the members of the committee, expresses the opinion that a portion of the program outlined by Walter Brown, the chairman of the committee, will be recommended.

Reclamation Advisers Hear Davis

The special advisers on reclamation spent the week ended Feb. 16 in consideration of the early activities in reclamation. Dr. Charles D. Walcott, who, as a former director of the U. S. Geological Survey, handled many of the initial activities in connection with reclamation, testified at length. Contrary to the announcement of Feb. 8, the advisers extended an invitation to A. P. Davis, who, for several days reviewed at their request, the history of various projects. It was stated that the matter of Mr. Davis' removal as director of the Reclamation Service was not discussed.

Road Bill Hearings Held Up

Hearings on the bill authorizing the appropriations for the new three-year federal aid highway program have been delayed by the consideration of other important matters in the House of Representatives. The hearings will begin early in March however. The hearings on this bill will be particularly exhaustive because one-third of the membership of the Committee on Roads are new members of the House. For that reason, Chairman Dowell has called upon the Bureau of Public Roads and the American Association of State Highway Officials to present facts and figures covering some of the major road-building activities.

Lake Michigan Water Diversion Bill Again in House

Washington Correspondence

A new effort is to be made at this session of Congress to secure authorization for the diversion of 10,000 sec.-ft. of water, from Lake Michigan, at Chicago. Representative Michaelson, of Chicago, has reintroduced the bill which was considered at the last session of Congress by the Committee on Rivers and Harbors. The bill provides that the cost of regulating works, intended to restore and maintain former water levels in the Great Lakes and their appurtenant rivers, is to be borne by the Sanitary District of Chicago.

The bill specifies either the St. Clair River, the Niagara River or the St. Lawrence River as the site of the proposed work. The measure also requires the Sanitary District "to proceed immediately with the installation of sewage purification works, to care for any excess population of the Sanitary District of Chicago over and above 3,000,000 people."

The Corps of Engineers did not report favorably on this bill when it was referred to that agency at the last session of Congress. Representative Michaelson blames Senator McCormick, of his state, for the failure of the committee to report out the bill at that time.

New York Engineers Discuss Vehicular Tunnel Control

Wilgus Leads Opposition to Transfer of Control to Port Authority As Now Constituted

The regular monthly meeting of the New York Section of the American Society of Civil Engineers on Feb. 13 was devoted to answering the query "Shall the construction of interstate vehicular river crossings be turned over to the Port of New York Authority?" Discussion was opened by Col. W. J. Wilgus, who stated at the very beginning that he was opposed to the transfer of the New York-New Jersey vehicular tunnel under the Hudson from the present interstate commission which controls it to the Port of New York Authority. This proposal had been made by Governor Silzer of New Jersey and Governor Smith of New York.

Col. Wilgus said that he favored *a* Port Authority but does not favor *the* Port Authority as it is constituted or its engineering plans. In direct discussion of the question of the evening he said that the present interstate board conceived the vehicular tunnel plan and had carried it out two-thirds the way toward completion. It would not be fair to them to turn it over now to a new body, because to do so would be to split responsibility. Further than that, the change would be dangerous financially because under the present proposal the tolls from the tunnel are to be fixed so as to amortize the total cost in about twenty years. If the Port Authority were to take it over, there would be no assurance that the tolls would stop at an amortization period; in fact, the Authority might use the tunnel as a source of revenue for other work in the harbor and the future free use of the tunnel might be indefinitely postponed.

Freight Transfer Tunnels Proposed

Col. Wilgus also criticized the recent suggestion of the Port Authority that there should be built other vehicular tunnels across the Hudson River from New York City to New Jersey and suggested instead the building of smaller size electric train tunnels for freight transfer across the river. Such tunnels could be built 50 per cent of the section of the large vehicular tunnel because the large space for ventilation would not be required and because also the trains running on tracks do not require so much side leeway as do trucks. In his estimate the same freight capacity could be had through a rail tunnel at a cost of $4,500,000 per line of traffic as against $13,000,000 per line of traffic in a vehicular tunnel. The total saving on the program for both would be $85,000,000.

(*Continued on p. 339*)

Michigan Engineers Meet at Port Huron

Discuss Highways, City Problems, Waterways, Metropolitan Detroit and Concrete

Engineering News-Record Staff Report

Approximately 150 engineers attended the convention of the Michigan Engineering Society, state division of the American Association of Engineers, Feb. 5, 6 and 7, at Port Huron.

The program was agreeably not crowded, giving ample time for discussion and excursions; two papers on highways, one on concrete control, one each on sewage, water and lake diversions, resources in the Northwest, 15 years' operation of the St. Clair Tunnel, comprised the principal topics.

Clifford Older, former state highway engineer of Illinois, outlined the results obtained from the $250,000 spent on the Bates Road tests and the concrete road design to satisfy those results. L. C. Smith, engineer-manager, Wayne County Road Commission, stated that many thousand dollars would have been saved to his county had the results been known ten years ago. Remarking on Mr. Older's resignation of his state position, Mr. Smith stated that when public servants become most valuable they cannot afford to stay.

Roadside Development

"Roadside Development" was the subject of a paper by J. M. Bennett, forester, Wayne County Road Commission, in which he took up all phases of roadside maintenance.

Roderick B. Young, engineer, Hydro-Electric Power Commission of Ontario, described the methods by which the quality of concrete was controlled in the work of that commission. A saving of 60,000 bbl. of cement was made on this job of 435,000 cu.yd. of concrete. (see *Engineering News-Record*, April 13, 1922, p. 613.) A further intangible saving of 85,000 bbl. was estimated when the designing engineers were finally convinced that it was safe to rely on the predicted strength obtained.

Sewage disposal in small communities was discussed by W. C. Hoad, professor of sanitary and municipal engineering, University of Michigan. Most of the operation difficulties arise, he said, from the lack of supervision and fool-proof devices. Major E. D. Rich, director, Bureau of Engineering, Michigan State Board of Health, urged development of a community conscience and the golden rule spirit by upstream communities. College graduates should operate the plants, in his estimation. They can afford to take the salaries offered and the disagreeableness of the job to them is obscured by their scientific interest.

A Detroit metropolitan area to take in a district 100 miles long and 30 miles wide skirting the Detroit River, Lake St. Clair and the St. Clair River to Port Huron is now under serious consideration in Detroit. George H. Fenkell, superintendent and general manager, department of water supply, Detroit, and C. W. Hubbell, consulting engineer, explained the water supply phases of the question. The area is developing rapidly and the towns away from the waterfront are nearly all hard pressed for water. Mr. Fenkell's recommendations for Detroit, however, are to take water near the present source at the head of the Detroit River and carry it across town by tunnel to a purification plant and pumping station near the future center of distribution.

Gardner S. Williams, consulting engineer, spoke on the diversion of water from Lake Michigan by the Sanitary District of Chicago and the present status of the proposed Great Lakes-St. Lawrence waterway.

Harry A. Shuptrine, treasurer, was elected president of the society.

Land Owners Heard at Colorado Bill Hearings in House

Hearings on the Colorado River bill before the House Committee on Arid Lands took an unexpected turn last week, when arguments by proponents of the bill were temporarily laid aside and plans taken up to have appear before the committee American citizens who are owners of affected Mexican lands, as well as representatives of power companies who might be interested in the proposed legislation. This followed the presentation of the principal argument in favor of the bill, by its author, Representative Swing, of California, and the hearing by the Committee of Secretary Hoover, chairman of the Colorado River Commission. Both of these gentlemen presented arguments previously made by them at other hearings, although Secretary Hoover testified that it was not economically feasible to transmit power so far as from Glen Canyon to Southern California, a distance something less than 500 miles.

Representative Swing said that subterranean interests were in opposition to his bill. He charged that there is an offensive and defensive alliance between owners of Mexican lands and power interests, working by devious ways, to defeat his measure. Representative Baker demanded that Harry Chandler, owner of the Los Angeles *Times*, and alleged by Representative Swing to be a prominent member of the Mexican landholding group, be subpœnaed, and that executives of the power companies also be summoned to testify under oath. Members of the committee desire to interrogate Mr. Chandler in regard to subjects relating to the proposed All-American canal.

Georgia Highway Engineers Meet

The first highway conference called by the Georgia State Highway Department was held at Athens Feb. 7-9 with the University of Georgia engineering faculty and students co-operating. Forty of the state highway staff were in attendance. The first day's sessions were presided over by John N. Holder, chairman of the highway commission, W. R. Neel, state highway engineer, presiding at succeeding sessions. Chief among problems discussed were those concerning sand-clay roads, right-of-way widths as determined by drainage and traffic needs, sand layers as interceptors of capillary saturation, and value and use of drainage tile.

Ohio Engineers Favor Gas Tax and Registration

Two-Day Sessions, Mostly on Highways, Take up Also Better Concrete, City Engineer's Status

Engineering News-Record Staff Report

Various phases of highway design, construction, operation, legislation and finance formed the major portion of the two-day convention of the Ohio Engineering Society which met Feb. 7 and 8 at Columbus and was attended by at least 250 engineers, county surveyors, county commissioners and contractors. However, one session was given over to problems of the city engineer. In the resolutions the following questions were approved or urged: A state highway police force; federal highway aid of $100,000,000 annually for three years; a gasoline tax for road maintenance, reconstruction and widening; appointment of competent and qualified men in the highway department, specifically urging engineers as inspectors; endorsement of the work of the Ohio Good Roads Association; a four-year term for county surveyors; removal of highway department from partisan politics; and unanimous support of an engineers' registration bill.

Technically, aside from direct highway reference, there was described by J. R. Burkey, engineer in charge, the seven-span, 1,317-ft. Conneaut reinforced-concrete viaduct on the Chicago-Buffalo Road, which the special committee of the American Society of Civil Engineers on concrete and reinforced-concrete arches is testing for pier movement, construction stresses, shrinkage, temperature changes and falsework loading. Tendencies in concrete paving design and new methods of concrete control by the Abrams' water-cement ratio method were handled respectively by E. W. James, Bureau of Public Roads, and Col. H. C. Boyden, Portland Cement Association.

Prof. H. S. Carter, University of Ohio, outlined the results of research on economic grade and location carried out under the direction of T. R. Agg at Ames, Ia. (*Engineering News-Record*, Jan. 10, p. 54.)

Highway Problems Discussed

Further in the session devoted to Ohio highways were papers on the whole problem from the administration standpoint by George F. Schlesinger, chief engineer; the traffic problem by H. J. Kirk, chief engineer of maintenance; bridge problems by A. W. Zesiger, chief engineer of bridges; construction equipment by A. Stellhorn, chief engineer of construction; macadam maintenance by H. S. Perry, assistant chief engineer of maintenance; and traffic bound construction by R. H. Smith, assistant engineer.

Papers were presented on the city engineer as a vital factor in public health problems, as a stabilizer of real estate values and as a spender of enormous public funds. The city engineer's status in Ohio was discussed by A Richards, city engineer, Chillicothe.

The officers elected are: President, E. A. Lawrence; vice-president, George F. Schlesinger; secretary-treasurer, John Graham, Chillicothe.

Minnesota Engineers and Architects Meet

Need Found for Professional Advisers to Municipalities to Raise Ethical Standards

Special Correspondence

Max Toltz, of St. Paul, was elected president of the Minnesota Federation of Architectural and Engineering Societies at their annual meeting held at Duluth, Feb. 1 and 2. Edwin H. Brown of Minneapolis, was elected vice-president; J. R. Stack of Duluth, 2nd vice-president; and G. H. Hutchinson, of St. Paul, treasurer. The board continued the services of Miss Katherine A. Feucht as executive secretary with offices at 1020 Guardian Life Building.

At the banquet Saturday evening at which 260 covers were laid, Charles F. Loweth, past-president of the American Society of Civil Engineers, and N. Max Dunning, vice-president of the American Institute of Architects, were the speakers. Some of the outstanding matters which came before the convention and called forth discussion was a progress report on the Great Lakes-St. Lawrence tide-water project; drainage developments in Minnesota and their relation to rainfall, wild animal, bird and plant life; the development of peat and lignite resources of the Northwest; and the development of low-grade iron ore in Minnesota.

Certain recent incidents in Minnesota relative to the selection of architects and engineers for public works brought forth a paper by Edwin H. Brown, discussions of which embodied the thought that a locomotive engineer or a stationary engineer in a village plant must have a certificate of skill and ability, but this is not required for the professional engineer on public works. Architects and engineers, it was stated, are to blame for this sort of thing more than anyone else. Public officials, selected by the governmental process now in vogue, ignorant of such inconsistencies, try to buy professional services as they buy pumping machinery.

Plan Suggested

The only man able to judge of the capabilities or skill of other men are their peers: engineers should judge engineers of the same branch of engineering, no other one can or should and yet any selection must be made by those authorized by law to do so. It was suggested that the Federation of Architectural and Engineering Societies, through its members which are from every location in the state, offer free of charge services of an engineer or architect, to each and every community that must employ one.

Suggestion also was made that the Federation pay his traveling expenses and that the man serve as professional adviser for the community, who will merely pass upon the qualifications of those men who submit their names for the job. He will ascertain most carefully who of this list are capable of doing such work and who are men of integrity. He will then turn over this list to the men of the local governing board who must make the choice.

Engineers Discuss Tunnel Control

(*Concluded from p.* 337)

Col. Wilgus finished his remarks with a general criticism of the Port Authority plan and the suggestion that an engineering board be employed by the commercial interests concerned in the New York port to make a thorough study of the whole subject of transportation in the metropolitan district. He also suggested the revision of the Port Authority scheme so that it would be more nearly like in constitution to the Port of London and the Port of Liverpool, where the authorities have representation from the rate-paying interests, the shipping interests, the rail interests, and the municipalities.

In the discussion J. Vipond Davies was inclined to believe that the Port Authority was the proper body to have final control of the vehicular tunnel, though he said it was inconceivable that the engineering organization in charge of the construction of the vehicular tunnel could be changed no matter who was in charge of it. C. M. Holland, chief engineer of the vehicular tunnel, reported the progress of that work. The shields are now just entering the under-river section and there should be an opening through by October of this year. He stated that the increase in cost from the estimate of 1919 of $29,000,000 to the present estimate of $42,000,000 was due to the increase in cost of ventilation which has been found to be nearly $4,000,000, in cost of labor and materials in the approach contracts, which had not been let at the time of the first estimate, in the architectural treatment of the tunnel, and in the size of the plazas which have to be very much greater than was thought at first on account of the increase in traffic. Arthur S. Tuttle, chief engineer of Board of Estimate of the City of New York, criticized the whole Port of New York Authority scheme and defended the Narrows tunnel which the City of New York is now building and which the Port Authority has refused to participate in.

W. J. Boucher defended the Port Authority. He said the Port Authority apparently was not seeking control of the vehicular tunnels, but having been asked to report upon crossings of the river by the Governors of the two states it had done so. He deplored the intimation of a number of the speakers that an investigation of the transportation facilities of the port was required and called attentiton to the very elaborate survey of this problem which the Port Authority has made.

Toward the end of the meeting a resolution was offered by Waldo Briggs, which was in two parts, the first that it was the sense of the meeting that the vehicular tunnel be not turned over to the Port Authority, and, second, that a board of engineers should be employed by private interests to study the transportation problems of the port. An attempt was made to have this laid on the table and to have it separated into its two component parts, but the proposer of the resolution did not agree to either proposition. The resolution was then put and lost.

Engineering Appointments to Philadelphia City Service

Engineer appointments in the new city administration in Philadelphia include the director of the Department of Public Works, the director of the Department of City Transit, the consulting engineer to the city, and the chief of the Bureau of Water.

George H. Biles is director of the Department of Public Works, succeeding Frank H. Caven. Mr. Biles was connected with the Pennsylvania State Highway Department for eighteen years, ending in March, 1923, when he resigned at the time the department was reorganized, being its acting head from January to March, 1923.

Henry E. Ehlers is director of the Department of City Transit, succeeding William S. Twining. Mr. Ehlers was formerly assistant chief engineer of the Public Service Commission of Pennsylvania, with which he was connected for ten years.

Solomon M. Swaab is consulting engineer to the city. Mr. Swaab has for many years been chief engineer of the Keystone State Construction Co., of Philadelphia, which position he retains. As chief engineer of this company, he had charge of the construction of the subway-elevated system of the Philadelphia Rapid Transit Co., the portion of the Broad Street subway that was built by the city, and the piers and anchorages of the Delaware River Bridge. The position he fills is a new one in the city administration.

Alexander Murdoch is chief of the Bureau of Water, succeeding Fred C. Dunlap. Mr. Murdoch was formerly a Philadelphia engineer, but had been city engineer of Chicago for two years previous to his appointment as chief of the Bureau of Water.

Governor Urges State Ownership of New Jersey Water Supplies

State ownership of the sources of water supplies of New Jersey municipalities, with immediate application to Northeastern New Jersey only, was urged by Governor Silzer in a special message submitted to the New Jersey Legislature on Feb. 12. The governor would have the state take over and consolidate existing sources of public and private supply, supplementing these by additional works as necessary; he would have the water supplied by the state wholesale to the several cities and towns at a cost to cover all operating and capital charges, including retirement of the bonds; and would have the state require all the municipalities to sell the water to private consumers by meter measurement. To provide money for state ownership, a bond issue authorized by state referendum is proposed, the bonds when issued to be based on the credit of either the state or the district which the corresponding works serve. When the bonds were all retired, the governor suggests, the income from the state-owned supply work, above current expenses, may be used for further development of the water resources of the state.

Indiana Engineers Hold Joint Meetings

Registration, Garbage Disposal, Motor Transport, Building Co-operation, Topics of Discussion

Engineering News-Record Staff Report

Combination meetings with other technical societies, a well-balanced program with never more than two papers per session, each well discussed, and a report of money in the bank and phenomenal increase of 80 per cent in membership (343 now), characterized the forty-fourth annual meeting of the Indiana Engineering Society, held Feb. 14 and 15 at Indianapolis. Aims and work of the Indiana Administrative Building Council in bringing the factors in the building industry together, an economic discussion of the motor truck problem, garbage disposal, future automobile mechanical developments when good roads are general, illumination of roads, workings of the engineers' registration law, an address on his South American trip, by Calvin W. Rice, secretary of the American Society of Mechanical Engineers and an exposition by Dean A. A. Potter, Purdue University, of the place of the modern technical school in its relation to industry and its contribution toward making good citizens while giving technical training, sum up the topics of special interest to the civil engineer. (The society embraces all engineers, the mechanicals and electricals being well represented.)

J. L. Elliott, in his address as president, deplored the weakness of the profession in the state because of the multiplicity of societies. With unity, new methods of financing (dues are only $4, of which $1 goes to A.E.C.), and co-operation, a year-around existence with suitable headquarters is entirely feasible in his opinion. Indiana is an enthusiastic supporter of both the American Engineering Council and the American Association of Engineers, two of its meetings being in conjunction with the latter organization. The other societies participating were the local sections of A.I.E.E., A.S.M.E., S.A.E., and the Scientech Club, indicating co-operation under Mr. Elliott's leadership.

PUBLIC WORKS DEPARTMENT ENDORSED

Endorsement was given to the A.E.C. resolution calling for a federal department of public works. Funds were urged for an adequate reserve officers corps and national guard. Following the discussion on the co-operative work carried on by the Administration Building Council and the advisory committee, consisting of delegates from the architects, engineers, contractors, and building mechanics, authorization was given for quarterly meetings at the same time as those held by the other three parties in the Advisory Committee. Codification of existing laws affecting building, standardization and structural requirements are being considered.

Garbage disposal experiments leading to the adoption of new processes and uses for the tankage were outlined by E. R. McCullough.

Registration of engineers has been in operation in Indiana since 1921 but registration under the "grandfather" clause was permitted up to September, 1923, the time being extended somewhat because of litigation on applications disallowed. Daniel B. Luten, a member of the Board of Registration, explained that the board considered its duty did not extend to enforcement of the infractions which are to be handled locally, violations being reported to the county prosecutor who will take the matter to the grand jury for indictment. In the last roster of registrants 1,208 engineers and land surveyors have been granted certificates.

The newly elected officers are as follows: President, E. R. McCullough; vice-president, George W. Hubley; new trustees, F. C. Atkinson, and H. M. Anthony.

Boston Technical Societies Dine

The annual dinner of the Affiliated Technical Societies of Boston was held on Feb. 12. This was the second dinner since formal affiliation took place but it counts as fifteenth in the list of dinners joined in by Boston engineers. An address on "Economic Fallacies" was made by Dr. Gus. W. Dyer, professor of Economics and Sociology, Vanderbilt University, Nashville, Tenn. Charles H. Eglee was toastmaster.

Fairmount Dam Bids Received

Bids were opened Feb. 14, by the Department of Public Works of the City of Philadelphia for the reconstruction of the Fairmont dam. The work involves the construction of a new masonry dam immediately downstream from the existing dam, and the repairing and strengthening of lock walls. The water level back of the existing dam is to be maintained during the construction. Bids were itemized under 16 different classifications. Five bids were received, as follows:

Seeds & Durham Co....	Philadelphia	$604,650
Frederick Snare Corp...	Philadelphia	622,400
The Arundel Corp.....	Baltimore, Md.	649,309
Eyre-Johnston Co....	Philadelphia	662,147
Dravo Contracting Co.	Pittsburgh, Pa.	685,000

Contractor for Tulsa Pipe Line Abandons Work

After completing 75 per cent of the 54 miles of 54- and 60-in. reinforced-concrete pipe line on the Spavinaw Water Supply Project, Tulsa, Okla., Walbridge-Aldinger Co., general contractors for the pipe line, abandoned the work on Jan. 29. Suit has been instituted against the Water Commission and the city for reformation of contract with claims of approximately $800,000. A restraining order to prevent the city from seizing the contractor's equipment under contract terms was refused by a Federal Judge R. L. Williams. The city has taken over the equipment and is proceeding with the work under the direction of W. R. Holway, engineer for the Water Commission.

The Lock Joint Pipe Co., sub-contractors under the Walbridge-Aldinger Co., are not involved in the controversy and are continuing to manufacture and lay the pipe.

Random Lines

Odor Engineering

Strong words of protest are contained in a letter recently sent the Health and Sanitation Committee of the Los Angeles City Council by the Hollywood Property Owners' Association. Here is an excerpt from the letter:

> Some place, we know not where, but we surmise the cesspool of Hades, there is produced a product which, when it arrives in Los Angeles, certain bipeds call fish fertilizer. We have digested the dictionary and find no word to define it but "stink"—a feeble word when one speaks of fish fertilizer. For if all the stinks of the earth from the time of the millennial dawn until the day of judgment were gathered together under one tent and concentrated into a single atom, it would only get third prize in a stink contest with fish fertilizer.
>
> The aforesaid fertilizer is spread upon parts of the soil of the city of Los Angeles . . . and then water is applied, and the aroma drives the birds to the mountains and snakes to their holes. A passing dog will flee to the poundmaster and beg to be chloroformed or drowned, and a polecat has been known to drop his tail in shame.

* * *

"Commissioner Hayes of the Department of Water Supply, Gas and Electricity wants an appropriation of $82,000 for the erection of fences around the city reservoirs. The object is to prevent the pollution of water by suicides. Which brings to mind Col. D. Streamer's—

> In the drinking well
> Which the plumber built her
> Aunt Eliza fell.
> We must buy a filter."

—F. P. A. in the New York *World*

* * *

Clearing Up Some Disputed Points

In 1882 Congress installed as a part of the Interior Department at Washington a group of topographical engineers. An analysis of their work is as complicated as it is simple. They are equipped with transits, instruments consisting of a tube that can be set at any angle and a graduated arc on the lower side that registers degrees of arc; chains for measuring distances, and an instrument called a plane table, which rests on three legs and makes a staple point which is called a bench mark. There is one other instrument in the equipment of the surveyor which is called a theodolite, which is set on a high mountain peak, or triangular station, as it is called, and which is the highest point that can be reached in the region being surveyed.

If you want to know more about those interesting creatures read the article about them, from which the above was taken, in the Rochester *Times-Union*, Dec. 10, 1923.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 11-13, 1924.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Sixteenth Conference, Los Angeles, Calif., April 7-10, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Atlanta, Ga., April 9-12, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., May 12-14, 1924.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

The Detroit Engineering Society and branches of four national societies will be addressed Feb. 29 by seven speakers representing five societies on "Additional Water Supply for Detroit." The various papers will cover population, growth, consumption and distribution, source, Lake Huron Project, purification, tunnels, costs and electric pumping. The Am. Soc. C. E., A.S.M.E., A.I.E.E. and A.A.E. are the national societies represented.

The Technology Club of Birmingham, Ala., at a recent meeting in honor of Mr. Dennison, executive secretary of the alumni, made a trip to the hydro-electric development of the Alabama Power Co. on the Coosa River and inspected Mitchell Dam and Lock 12.

The Colorado Society of Engineers held its annual meeting in Denver, Jan. 19, and after an address by Mayor Stapleton of Denver, elected the following officers: President, F. C. Steinhauer; vice-president, R. J. O'Rourke; secretary-treasurer, C. M. Lightburn.

The Illinois Section, American Water Works Association, will meet March 19 and 20 at Urbana-Champaign.

The San Francisco Section, American Society of Civil Engineers, on Feb. 11 gave a dinner in honor of C. E. Grunsky, recently elected president of the American Society of Civil Engineers. Invited guests represented local sections of other national engineering societies, the American Bar Association and several local organizations with which Mr. Grunsky has been identified. The program included a humorous review of his boyhood career and, in serious vein, an appreciation of the effectiveness of his professional work.

Personal Notes

H. B. MUCKLESTON, for the past four years chief engineer of the Lethbridge Northern Irrigation District at Lethbridge, Alberta, announces that he has opened an office at 901 Rogers Building, Vancouver, B. C., for practice as a consulting engineer in structural engineering, foundations, irrigation, power, water supply and purification, and in reports and valuations in these lines. Mr. Muckleston is a native of Kingston, Ont., and graduated in civil engineering from the Royal Military College, with rank of lieutenant of engineers. Prior to his work at Lethbridge he was for seventeen years in the employ of the Canadian Pacific Ry. on design and construction of their large irrigation systems in Alberta. The Lethbridge project was described in *Engineering News-Record* Feb. 7, p. 243. It serves an area of 105,000 acres and involved an expenditure of $5,400,000.

J. L. BAER, civil engineer with the Big Four R.R. on the St. Louis Division, has been appointed city engineer of Wabash, Ind., succeeding PAUL LATCHEM, resigned. Mr. Baer has also been with the Pennsylvania R.R. for a number of years. He is a graduate of Illinois University.

HARRY MEIXELL has resigned the secretaryship of the Motor Vehicle Conference Committee of the National Automobile Chamber of Commerce, to become general manager of the Mortgage and Title Guaranty Co. of New Jersey, effective March 1. He also leaves the post of secretary of the legislative committee of the National Automobile Chamber of Commerce. RUSSELL HUFFMAN who has been assistant to Mr. Meixell in these offices succeeds him as secretary.

NELSON P. LEWIS, recently consulting engineer to the Board of Estimate of the City of New York and now director of the physical survey of the Plan of New York and Its Environs, has not been well for several months and went to the Brooklyn Hospital on Jan. 28 for a prospective operation. A preliminary operation was performed and a second one has been pronounced successful. His condition at the present time is satisfactory and there is every reason to believe he will regain his entire health in a short period.

CHARLES A. PARK, first assistant superintendent of lighthouses, Detroit, has been appointed superintendent in charge of the Eleventh District, said to be one of the most important in the service, since it has nearly 400 employees who care for 388 lighter aids to navigation, 983 aids of all classes, four lighthouse steamers and five light vessels.

J. D. CARPENTER, W. H. CORDDRY and F. H. EASTMAN, for years connected with Gannett, Seelye & Fleming, have been admitted to partnership in that consulting firm. Mr. Carpenter, a graduate of Pennsylvania State College, has been office manager for a number of years; Mr. Corddry has been with the firm since 1916, except a year or so when he served overseas during the World War. He has been made vice-president and manager of the Memphis office. Mr. Eastman, who has been made manager of the construction department, is a Dartmouth graduate.

LIEUT.-COL. A. E. DUBUC, supervising engineer of the Quebec canals, has been appointed acting chief engineer of the Canadian Department of Railways and Canals to succeed W. A. Bowden, whose death was noted last week in these columns. Previous to the World War, Colonel Dubuc was engaged on canal work under the Canadian Department of Public Works, being assistant engineer of the department at Ottawa and district engineer at Montreal.

HAWLEY & ROBERTS, consulting engineers, Ft. Worth and Lubbock, Texas, is the name of the new firm formed by MAJOR JOHN B. HAWLEY of Ft. Worth and H. N. ROBERTS of Lubbock. The firm has been retained by the city of Lubbock on its extensive paving program. The city of Lubbock is the location of the new Texas Technical College and its city limits have recently been extended by the addition of new sections.

Obituary

NORMAN MCNEIL, a civil engineer of the State Highway Department of Maine, died at his home on Jan. 29 at the age of 45 years. Mr. McNeil, who came here from Upton, Wyo., less than a year ago, was in charge of bridge construction in the eastern part of the state of Maine.

WILLIAM W. SLATER, originator of many railroad signal devices, died at his home in Oakland, Calif., Jan. 18, aged 75 years. Mr. Slater had been connected with the Southern Pacific Ry. for thirty years when he retired in 1914. His work had included the first successful automatic block signals for single-track lines.

FRANK E. KINSMAN, originator of an automatic railway signal system installed on the New York subways, the Hudson tubes and the Boston Elevated Ry., died Feb. 6 at his home in Leominster, Mass., aged 72 years. He was also connected with pioneer telephone work in the establishment of central offices and switchboards.

ALEXANDER L. HOERR, for eighteen years chief engineer of the National Tube Co.'s plant at McKeesport, Pa., died Jan. 28 of pneumonia, at the age of 50 years. Prior to going to McKeesport Mr. Hoerr was connected with the Jones & Laughlin Steel Co. in an engineering capacity. He was a graduate of the Engineering School of Western Reserve University.

B. L. KNOWLES, manager of the publicity department of the Worthington Pump Corporation, died on Feb. 14, after a short illness. Death was caused by cerebral hemorrhage. Mr. Knowles was 45 years old and been in the employ of the Worthington company for twenty-eight years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Radical Changes in Making Pipe Are Predicted

New Methods Developed by Research May Lead Foundries to Revise Production Methods

IMPORTANT developments in the art of cast-iron pipe making this year are predicted by the American Cast Iron Pipe Co., Birmingham, Ala. Improvement of manufacturing methods made progress in 1923, but except for the perfection of the DeLavaud method of centrifugal casting, the research activities that have been going on for several years did not reach the point at which manufacturers were willing to make detailed public announcements. It now appears, however, that the experimental stages of other methods are about complete and that before another year is ended there will be operating on a commercal basis new methods of production. How such developments may affect the industry can be only a matter of conjecture at this time. The outlook, as seen by the American Cast Iron Pipe Co., is summed up in the following statement prepared by that firm for *Engineering News-Record:*

PIPE INSTALLATIONS DELAYED

"The mortality rate in the cast-iron pipe business for the past quarter of a century has been very high—something like 75 per cent. The production, or possible production of cast-iron pipe based on foundry capacity during this time has exceeded the demand, except for the past two years. During the war this country got badly behind with water and gas installations because government war regulations restricted pipe making and consumption in many ways. The volume of business during the past two or three years, therefore, has been larger than ever before to compensate for these delayed installations.

"Some of those most closely connected with the industry, however, feel some concern for the future. To the 'normal' high rate of failure which the industry has experienced in the past, now probably will be added the difficulty of adjusting foundries to entirely new methods of production. In a general way, this will mean, in all probability, the amortization of existing pipe-making equipment, in which has been invested millions of dollars. Of course, the improved methods that seem about to materialize should be of tremendous benefit to the users of cast-iron pipe. They have been conceived and developed by the industry itself with this in view. It is only frank to state, however, that when these ideas were first conceived, few connected with the pipe business fully realized what the necessary readjustments would cost the industry nor how serious in some cases the resulting problems would be."

A. G. C. Queries Equipment Makers on Standards

Washington Correspondence

Letters are being sent to equipment manufacturers by the Associated General Contractors outlining a proposal to create a Manufacturers' Bureau of that organization to include both producers and consumers of construction equipment, in order to handle questions of standardization of specifications and other matters of common interest. This action is in line with a request from prominent manufacturers submitted to the executive board of the A.G.C. at Chicago last month, as announced in *Engineering News-Record,* Jan. 31, p. 217. The association also has under consideration plans for broadening the proposed new work by including in the bureau manufacturers of construction materials.

All interests apparently recognize the need for standard specifications, and the suggestion has been made to the Associated General Contractors, as representing the consuming interests, that a bureau under its general direction could accomplish much in this direction. While all details will not be settled until the views of the manufacturers are known more fully, the idea has been advanced that the contractors should clearly specify their needs in the various lines of equipment, then bring in the manufacturers to work toward agreement which would satisfy these needs. Standardization of capacities is said to be the outstanding need.

The A.G.C. has worked out standards for wheelbarrows, which have been accepted by 98 per cent of the producers, except that manufacturers' numbers are not comparable, a detail which is now being straightened out. The association also has secured agreement on general standards for mixers.

It is proposed also that the Manufacturers Bureau exchange information on developments in machinery, further the effort toward elimination of seasonal operations and perform other functions of mutual benefit, and that the plan of organization be by groups of producers of the same equipment.

Fire at J. D. Adams Plant

On Feb. 1 a spark dropping from an electric hoist in the painting department of J. D. Adams & Co., Indianapolis, manufacturers of leaning-wheel road graders, started a fire which burned a portion of the manufacturing plant. The loss on buildings and material was largely covered by insurance. Plans were immediately drawn for a new building of fireproof construction on which work is now in progress. Pending its completion the company states that its existing stock of equipment will be sufficient to fill orders for several months.

Blaw-Knox to Finance Industrial Buildings

President Lehman Announces New Extended-Payment Plan for Structures Costing $1,000 to $50,000

AN APPLICATION of the extended-payment plan for financing the purchase of standardized steel industrial buildings has just been announced by the Blaw-Knox Co., Pittsburgh, through its president Albert C. Lehman. It will apply to such structures as factories, warehouses machine shops and garages costing from $1,000 to $50,000, and follows in its general principles the partial payment idea which has been widely used in the sale of automobiles and household goods.

"The new Blaw-Knox building finance plan," Mr. Lehman explained, "puts the purchase of industrial structures on a 'pay-as-you-earn' basis. It has been developed by financial experts. To the industrial executive we offer to finance and supply the needed structures so that any business, large or small, may have the same extension of credit as they, in turn, extend to others. Speed is vital to success in meeting demand and competition. As against a construction period of six months or more in past years standard steel factory buildings today can be available in 30 days. They can also be enlarged quickly by ordering additional standard units."

Big Purchase of Road Equipment Planned by Penn. Highway Dept.

To meet its requirements for road-building equipment during 1924, the Pennsylvania State Highway Department contemplates the purchase of an extensive line of machinery, bids for which are to be opened Feb. 21 in Harrisburg. The official announcement of this letting states that "award will be made on the basis of quality of material, price, and ability of the bidder to carry out the contract." Some of the more important items on which manufacturers are asked to submit prices are indicated below:

Thirty portable gasoline-engine air compressors, with piston displacement of 90 cu.ft. per minute, together with 30 self-rotating rock drills equipped with bit-retainer and handle shut-off, each capable of operating a 12-ft. drill in a 1¼-in. hole; 34 belt conveyors operated by gasoline engine and mounted on a two-wheel truck; five jaw stone crushers on four-wheel truck mounting, together with 30-ton wooden bins and 12-ft. revolving screens; 5 steam traction engines for operating the crushers.

In addition the state highway will buy 33 gasoline-engine-driven concrete mixers (10-ft. capacity dry), mounted on four-wheel trucks; 13 gasoline-engine-driven pumps, on four-wheel truck mountings, with a capacity of 18 to 22 gal. per minute against a head of from 175 to 200 ft; 19 three-wheel, 10-ton gasoline road rollers and 4 3-ton gasoline rollers; 24 dump wagons (1½ yd.) and 21 two-horse, 2-yd. revolving metal cone chip spreaders.

In addition, there are calls for a large quantity of miscellaneous equipment, including 398 road drags.

Business Notes

GRAMM-BERNSTEIN MOTOR TRUCK CO., Lima, Ohio, announces the purchase of its property by a reorganization committee and its transfer to a new corporation, to be known as the Gramm-Bernstein Truck Corp. Subject to formalities of court procedure, the receivership of the old company will be closed and the new company will take over the property and start operations.

WATSON TRUCK CORP., Canastota, N. Y., announces that it built more dump wagons in 1923 than in any other year of the company's history. An increased production program is planned for 1924. The plant has been enlarged and new equipment added.

CHICAGO PAVING LABORATORY, INC., has moved its offices to the Lake Shore-Ohio Building, 536 Lake Shore Drive, Chicago.

OSHKOSH MANUFACTURING CO., Oshkosh, Wis., manufacturer of concrete mixers, saw rigs, and logging tools, announces a change of name to the Leach Co.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of electric welding equipment, announces the appointment of Glenn A. Wilson as manager for New York and New England territory, with headquarters at 120 Liberty St., New York; Mr. Wilson formerly represented the Mutual Electric & Machine Co.

TRAILER MANUFACTURERS ASSOCIATION, at its annual meeting held in Detroit, elected the following officers: President, M. E. Crow, of the Troy (Ohio) Trailer & Wagon Co.; first vice-president, H. C. Fruehauf, Fruehauf Trailer Co., Detroit; second vice-president, S. B. Winn, Lapeer Trailer Corp, Lapeer, Mich.; secretary-treasurer, Henry M. Wood, Trailmobile Co., Cincinnati. Allan P. Ames was appointed manager of the association and headquarters were established at 115 Broadway, New York.

H. D. CONKEY & CO., Mendota, Ill., announce the appointment of H. P. Duval as sales agent for hand power and electric cranes in the territory of Kansas City, Mo. S. A. Gilliard has been appointed sales agent for the Buffalo, N. Y., territory.

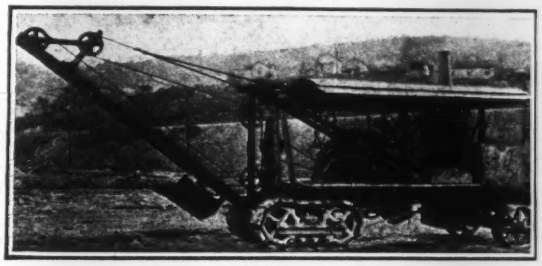
S. MORGAN SMITH CO., York, Pa., manufacturer of water wheels, has added to its engineering and sales staff D. J. McCormack, H. E. Popp and H. T. Porter, formerly with the hydraulic turbine department of the Wellman-Seaver-Morgan Co., Cleveland. Mr. McCormack and Mr. Popp are located at the main office and works in York, Pa., while Mr. Porter becomes manager of the company's Chicago office.

NORTHWEST ENGINEERING CO., Chicago, announces the opening of an office in the Central Bank Building, Memphis, Tenn., in charge of M. B. Rider, who will have jurisdiction over the sales of the company's crawler cranes, shovels, draglines, and trench pull shovels in Tennessee, Mississippi, Arkansas, Alabama, Louisiana and Texas. Mr. Rider was formerly connected for two years with the sales organization of the Bethlehem Steel Co. and for six years with the Lakewood Engineering Co. He is a civil engineer graduate of New York University and his practical experience includes service on the New York City subways, the New York State Barge Canal, and with the National Bridge Works.

Equipment and Materials

Half Crawlers and Pull-Stroke Scoop for Traction Ditcher

Crawler treads on the front end of the machine, instead of the former four-wheel mounting, and a back-action, pull-stroke ditching attachment are new features of the 16-ton traction excavator manufactured by the Keystone Driller Co., Beaver Falls, Pa. The machine is regularly equipped with a steam boiler, but may be furnished either with electric motor or gas engine drive.



TRACTION DITCHER WITH SKIMMER SCOOP (LEFT) AND PULL SHOVEL (RIGHT)

In place of the standard skimmer scoop there may be substituted the pull-stroke ditcher attachment with drop-bottom bucket shown in the illustration at the right. The bucket is made in seven widths from 14 to 54 in., and digs trenches to depths of 18 ft. The 24-in. ditcher bucket used holds about ¼ cu.yd. In addition to ditching, this attachment is used for backfilling.

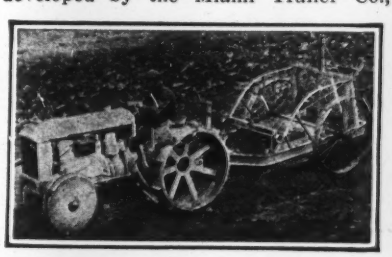
With the ⅝-yd. skimmer scoop attachment the length of the horizontal crowd is 14 ft., which, the manufacturer of the machine points out, renders this equipment particularly useful on street and road excavation. By the use of a boom extension the machine can be arranged to handle a ½-yd. clamshell bucket.

The new half-crawler mounting is under the digging end of the machine, which is subjected to the greatest weight and digging stresses.

Power Scraper Tractor Operated

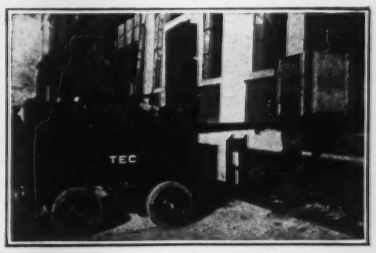
Designed for operation with a Fordson tractor, the one-man power scraper developed by the Miami Trailer Co., Troy, Ohio, consists essentially of an 18-21 cu.ft. pan or scoop carried by a steel frame mounted on two wheels and raised or lowered by a ⅜-in. cable extending to the drum of a winch on the rear-axle housing of the tractor. This drum is driven by a friction clutch, taking its power from the tractor belt pulley arm. The movement of the scoop is controlled by a lever from the tractor driver's seat. When filled, the scoop is elevated and held at a 15 deg. angle until the dumping point is reached. Here, through movement of the control lever, the pan is elevated and tilted, allowing the earth to discharge at the rear.

The equipment is of all-steel construction and may be detached from the tractor in a few minutes. The power winch does not interfere with the regular hitch and may be left on the tractor permanently, as it operates only when the friction clutch is engaged.



Four-Wheel Drive Industrial Truck Has Elevating Platform

A four-wheel drive and large-size wheels with thick rubber tires for operation over cobble pavements or other rough surfaces are features of the electric storage-battery truck with elevating platform developed by the Terminal Engineering Co., New York. It will be noted from the accompanying illustration that the usual small-diameter pilot or trailer wheels have been eliminated. While the truck is built in three models for lifts of 4 ft., 5 ft. 2 in. and 8 ft 6 in. the platform, in all cases, may be lowered to a surface height of 5 in. from the floor.



The hoist will raise a 3,000-lb. load at a speed of 25 ft. per minute or will elevate, empty, at 50 ft. per minute. The truck is carried on four wheels having 20x5-in. solid rubber tires 3 in. thick. Each of the four wheels is individually driven by a motor through a reduction gear and pinion, power being supplied by a storage battery. Steering is done by the rear wheels. The overall length of the truck with a 4-ft. platform is 120 in. and with a 6-ft. platform, 148 in.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Municipal Bond Sales for January Lower Than December Total

The total value of January bond sales was less than that for the month of December, also below that of January, 1923. *The Commercial and Financial Chronicle* reports January disposals at $91,027,291, compared with $112,060,273 in December and $96,553,380 for January, 1923. The January figures are noticeable for the lower number of separate issues and the increase in the number of large sales. The cities of Philadelphia and Los Angeles each placed blocks of $5,000,000. Rochester, N. Y. disposed of securities totaling $4,200,000. Tacoma, Wash. awarded to firms in that city bonds for $4,000,000. The State of Kansas placed bonds for $3,500,000. Pueblo Conservancy District created under the Colorado Conservancy act of 1922 awarded $3,600,000. The State of Michigan issued $3,000,000 in road bonds, and the State of Virginia disposed of the same amount of highway issues. The State of South Dakota awarded rural credit bonds amounting to $3,000,000.

Among the important issues made by cities are the following: St. Paul, Minn., $2,500,000; Providence, R. I., $2,000,000; St. Louis, Mo., $2,000,000; Yonkers, N. Y., $1,766,000.

In the accompanying table, six were sold below par, fourteen at par, and thirty-five above par.

Eighteen of the awards were issued at 5 per cent, sixteen at 4½ per cent, and six at 6 per cent.

St. Louis Painters Demand Wage Advance

"Warning! Stay Away From St. Louis, Mo." is the heading of a poster being sent broadcast by the Painters District Council of St. Louis over the signature of Charles J. Eisenring, secretary. The warning continues:

"Owing to the false and persistent reports regarding the great amount of work in St. Louis as the result of the passage of the bond issue program there has been an influx of building mechanics here, very few of whom are able to obtain work. The bond issue program is to be carried out over a period of 10 years and, as the greater part of the expenditure is to be for street, parkway and lighting improvements, there will be very little work for painters, paper hangers, glass workers and similar crafts. In addition trouble is expected this Spring due to the expiration of contracts March 1. Building mechanics are walking the streets now and hundreds may be idle then. So take this tip and stay away."

The reference to the possibility of trouble indicates that the painters expect opposition from the employing painters to their recent demands for a five-day week with wages of $12 per day, double time for Saturday and Sunday work to take effect March 1. St. Louis wage scales are the highest in the country at the present time.

REPRESENTATIVE PUBLIC BOND SALES, JANUARY, 1924

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
New Jersey	Highways	$5,000,000	4½	100.25	4.24	Jan. 1	1934	Various banks of the state
	Roads	3,000,000	4¼	100.125	4.235	Jan. 1	1934	Various banks of the state
New Mexico	Highways	500,000	5	102.03	4.69	Jan. 1	1952	Kissel, Kinnicutt & Co., and others
West Virginia	Highways	3,000,000	4½	100	4½	Apr. 1	1933—44	Bankers Trust Co. and others
County								
Atchison, Kan.	Roads	18,000	5	100	5	Oct. 10	.....	Kansas School Fund
Athens, O.	Roads	53,000	5½	100	5½	Nov. 1	1925—33	Athens National Bank
Chenango, N. Y.	Roads	100,000	4½	102.62	4.25	Feb. 1	1936—40	National Bank of Norwich
Cherokee, Kan.	Roads	51,641	5	100	5	Jan. 19	Yearly	Cherokee County State Bank
Cottonwood, Minn.	Drainage	72,500	4½	100.24	4.738	Dec. 1	1929—43	Northern Trust Co. of Duluth
Chippewa, Minn.	Drainage	9,200	5½	100	5½	Nov. 13	.....	Northwestern Trust Co. of St. Paul
Delaware, O.	Roads	99,900	5½	100.97	5.05	Sept. 1	Yearly	Detroit Trust Co. of Detroit
Franklin, O.	Roads	41,630	5½	101.53	5.15	June 15	1924—32	Breed, Elliott and Harrison of Cincinnati
Greene, Ind.	Roads	46,500	5	100.90	4.954	.....	.....	Fletcher American Co. of Indianapolis
Jefferson, O.	Roads	46,400	6	103.27	5.25	Aug. 1	1924—31	The Title Guaranty Trust Co. of Cincinnati
Lake, O.	Water supply	160,000	5½	104.44	5.09	Oct. 1	Yearly	Guardian Savings Bank & Trust Co. of Cleveland
Lucas, O.	Ditch impvt.	72,664	5½	100.58	5.32	Jan. 15	Yearly	W. L. Slayton & Co. of Toledo
Marion, Ore.	Roads	105,000	5½	104.082	4.94	July 15	1933	E. H. Rollins & Pierce, Fair & Co. of Portland
Martin, Minn.	Drainage	26,000	4½	100.461	4.69	Jan. 1	1928—42	Minnesota Loan & Trust Co. of Minneapolis
Middlesex, N. J.	Roads	336,000	4½	101.353	4.33	Aug. 1	Yearly	Austin, Grant & Ogilby of N. Y.
	Bridge	50,500	4½	100.98	4.40	Aug. 1	Yearly	
	Bridge	151,000	6	98.33	6.18	Feb. 1	1929—54	Caldwell & Co. of Nashville
Monroe, Fla.	Road	149,000	6	98.33	6.18	Feb. 1	1929—54	
Norfolk, Va.	Road and bridge	280,000	5	98.28	5.14	Jan. 1	1944	Sidney Spitzer & Co.; Prudden & Co. of Toledo
Newcastle, Del.	Roads	200,000	4½	97.69	4.65	June 1	1944—57	Merrill, Oldham & Co. of Boston
Sandusky, O.	Roads	45,000	5	100	5	July 1	Yearly	Sandusky County Bank
Shawnee, Kan.	Roads	150,000	4½	99.62	5.78	Nov. 1	1944	Guaranty Trust Co. of Kansas City
	Roads	65,356	5	100	5	Dec. 1	Serially	Columbian Title & Trust Co. of Topeka
Travis, Texas	Road	1,140,500	5	.....	.....	Feb. 1	1925—52	Harris, Forbes & Co., and others
Yates, N. Y.	Roads	100,000	4½	100.93	4.36	Mar. 1	1929—33	Geo. B. Gibbons & Co. of New York
Township								
Goldwood, O.	Sidewalks	11,539	6	.....	.....	Sept. 1	1924—28	Local contractors
Jackson, O.	Roads	2,835	6	100	6	Sept. 15	.....	Citizens Bank of Mt. Blanchard
Munson, O.	Roads	5,500	5½	100	5½	Aug. 1	1924—32	Griswold Security Co. of Cleveland
Neville, Pa.	.....	40,000	4½	100.22	4.47	Dec. 1	1924—31	The Union Trust Co. of Pittsburgh
Noble, O.	Roads	11,000	6	100	6	July 1	1925—29	Home Banking Co. of St. Marys
Waltz, Ind.	School building	62,000	5	101.88	4.74	Jan. 15	Yearly	The Fletcher American Co. of Indianapolis
Municipalit								
Alliance, O.	Impvt.	77,927	5½	100.92	5.27	Sept. 1	Yearly	W. L. Slayton & Co. of Toledo
Atwood, Kan.	Waterworks	30,000	5	100	5	Mar. 15	1943	Brown, Crummer Co. of Wichita
Austin, Tex.	Impvt.	850,000	5	100	5	Jan. 1	1925—64	Texas Bank & Trust Co. of Austin
Bloomfield, N. J.	Sewer	110,000	4½	100.22	4.84	Jan. 1	1925—64	Bloomfield Trust Co.
	School	258,000	4½	100.13	4.47	Jan. 1	1925—44	Bloomfield Trust Co.
	Impvt.	74,000	4½	100.13	4.47	Jan. 1	1930	Bloomfield National Bank
Chelsea, Mass.	Paving	137,500	4½	100.67	4.32	July 1	1924—33	Estabrook of Boston
	Macadam	75,000	4½	100.67	4.32	July 1	1924—28	
Galveston, Tex.	Grade raising	1,250,000	5	.....	.....	Jan. 1	Yearly 39 yrs.	Farson, Son & Co. of New York
	Street impvt.	100,000	5	.....	.....	Oct. 1	Yearly 40 yrs.	Otis & Co. of Cleveland
	Waterworks	125,000	5	.....	.....	Oct. 1	Yearly 35 yrs.	and others
Grand Rapids, Mich.	Streets	197,000	5	101.37	4.68	Dec. 1	1926—43	Eldredge & Co. of New York
	Streets	244,000	5	101.37				
	Sewer	70,500	5	101.37				
	Sewer	47,200	5	101.37				
	Water	75,000	4½	101.37				
Providence, R. I.	Water supply	2,000,000	4½	98.45	4.33	Feb. 1	1964	Harris, Forbes & Co. of New York
St. Paul, Minn.	Water	1,000,000	4½	4½	.....	Jan. 1	1925—54	A syndicate composed of Eldredge & Co. of New
	School	1,000,000	4½	4½	.....	Jan. 1	1954	York, Wells-Dickey Co. of Minneapolis
	Impvt.	500,000	4½	4.44	.....	Jan. 1	1944	Lane, Pipe & Jaffray, Inc., of Minneapolis

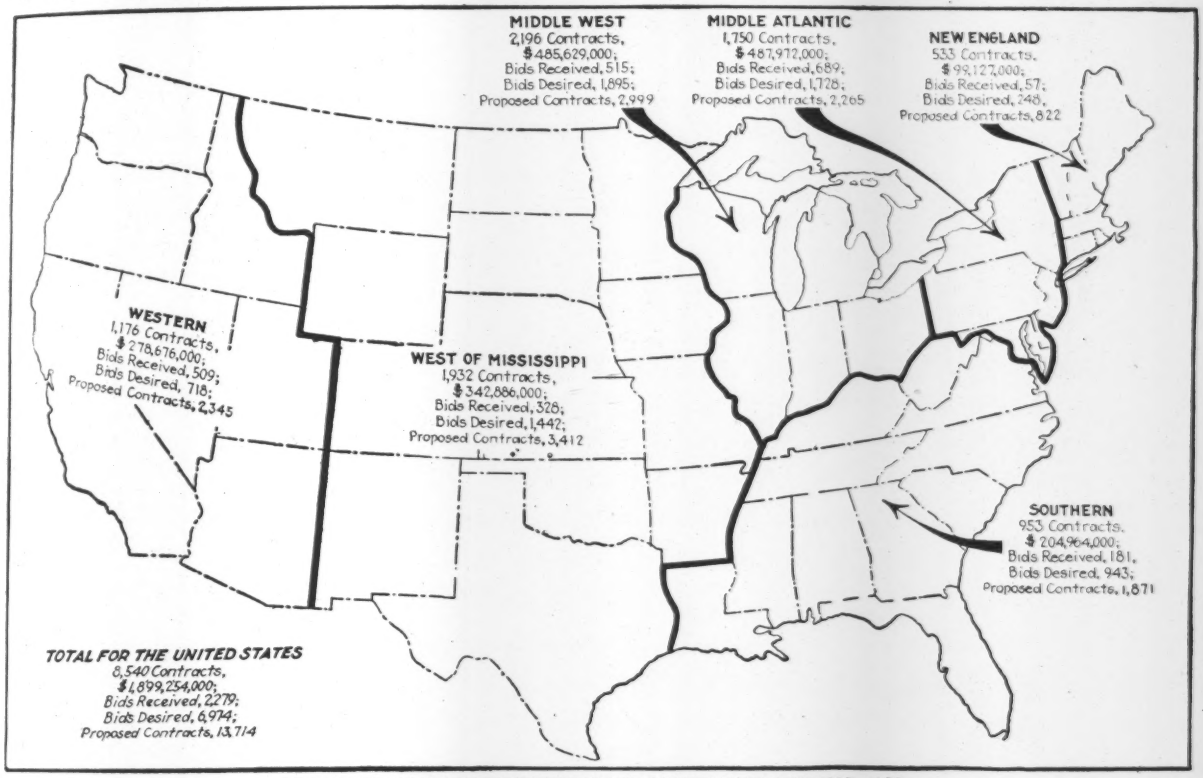
How 1923 Contracts Were Distributed

A total of 8,540 contracts awarded in the United States during 1923, on large engineering construction projects, are shown geographically distributed, in the accompanying illustration.

Information regarding each one of these important projects was published from time to time in the Construction News section of *Engineering News-Record*. The project was followed from the time the idea was proposed, on through the "bids wanted" and "bids received" stages to the awarding of the contract. Information was published on 7,756 contracts during 1922.

The total number of all items, including proposals, bids desired, bids received and contracts let, numbered 31,507 in 1923, compared with 27,051 published during the preceding year.

Taking $15,000 as a minimum on water-works; $25,000 on all other public works; $40,000 on industrial construction and $150,000 on commercial buildings, the total value of lettings on all large projects in the United States, aggregated $1,899,254,000 for 1923, against $1,556,550,000 in 1922. Taking all smaller construction into consideration, the total for 1923 would be approximately $6,000,000,000, or 22 to 25 per cent ahead of 1922.



GEOGRAPHICAL DISTRIBUTION OF CONTRACTS DURING 1923

Materials Stocks Adequate

Although the present tendency is toward a seasonal slowing down in the production of building materials, the 3 per cent increase in the January iron and steel output may be taken as an indicator of the possible trend of other industries during the next four weeks.

Latest reports of lumber cutting show a gain of 3 per cent in one week. Burned common brick on hand at yards throughout the country, however, decreased 6 per cent in one month, and the January cement output fell off 12 per cent from the month preceding.

Despite these reduced production schedules, mill reserves and dealers'

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Hollow tile, Detroit, deliveries take several days); and stocks on hand in general terms, example: (Sewer pipe, Cincinnati, plenty.)

	San Francisco	Los Angeles	Denver	Detroit	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Stocks in usual good condition	Dealers behind with orders	Still slight shortage	Moderate local supply in yards	Plenty	Satisfactory; demand fair	Del. require 4 to 5 days	Shortage in sizes above 24 in.
Cement	Fairly well supplied	All plants active	Enough	Plenty, local dealers' stocks and nearby mills	Large stocks	Plenty; fair demand	50 cars	Plenty; dealers' stocks small but mill del. prompt
Lime	Stocks in fair shape	All plants active	Sufficient	15 to 20 carloads in warehouses	Sufficient to meet demand	Ample	60 cars	Market well supplied
Common brick	Dealers' stocks in good shape	Demand well supplied	5,000,000	Good supply common in yards; small stocks of paving	Enough	Sufficient	Plenty	Enough in winter storage
Hollow tile	Large reserves	Meeting demand	Stocks replenished	Small supply. Large del. require several days	Ample	Enough	Del. require 4 to 5 days	Supply good; water deliveries prompt
Lumber	Over supply, mostly fir	Heavy shipments from North Pacific coast	Normal	10,000,000 ft. b.m.	Plenty	Pine orders exhaust production	Plenty	Del. take 5 to 6 weeks from mill to dock
Asphalt	Very large native reserves	Supplies meet steady demand	Sufficient	Enough to meet paving requirements	Kentucky rock plentiful	No market	50 cars	Heavy reserves in N. J.
Structural steel	Bars easily obtainable from local mills; plenty structurals	Sufficient for requirements	Warehouses well stocked	.....	Replenishing warehouse stocks of structural shapes	Satisfactory quantity; fair demand	5 to 7 cars	Small tonnage sales not affecting warehouse stocks

warehouse stocks are ample with very few exceptions.

Sewer pipe, particularly in sizes above 24-in., has shown a tendency toward scarcity in several important centers, namely, New York, Los Angeles, Denver and Chicago. This condition is no doubt due to the fact that the 1923 sewer construction program was the heaviest, in value of contracts awarded, for any year since 1918.

Aside from a slight scarcity of paving brick and hollow tile in the Detroit district and a recent heavy demand for long-leaf yellow pine in the New Orleans market, most other basic building materials will face no possibilities of shortage until the spring demand gets into full swing. A general impression of the availability of building materials may be gained from the accompanying table.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 97 to 108, are the following:

Office, Huntington, W. Va., for Coal Exchange Bldg. Co. $1,000,000.

Club, Boston, Mass., for University Club, $2,000,000.

High School, Bradford, Pa., School Board, $1,000,000.

Hospital, Jamaica, N. Y., Mary Immaculate Hospital, $1,500,000.

Large Contracts Let During Week

Among the week's announcements of Contracts Awarded in Construction News, pp. 97 to 108, are the following:

Generating Plant, Knightville, Me., to Foundation Co., New York, $1,000,000.

Factory and Dyehouse, North Canton, O., to Hunkin-Conkey Constr. Co., $1,000,000.

Office, New York, N. Y., to G. Richard Davis & Co., Inc., $2,000,000.

Apartment Hotel, New York, N. Y., to Todd, Robertson & Todd, $18,000,000.

Reservoir, Seattle, Wash., to Jahn & Bressi, $1,210,000.

Hotel, Long Beach, Calif., to Stradley & Newton, Los Angeles, $2,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Feb. 7; the next, on Mar. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	5.15	5.00	4.05	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	53.2%	43%	47%	—55.05%	36%	37.10@47.40%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	56.00	61.00	57.20@60.20	61.50	+69.00	59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.72
Gravel, ¾ in., cu.yd.	2.00	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.42	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+62.00	40.00	54.75	58.00	43.75@45.00	+.52@.57	36.00	29.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65@25.85	12.00	11.60	11.00	16@18	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.064	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.97	+1.03	1.10	.94	1.05	1.15	1.03	1.15	1.18
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.40@.45	.35@.50	.50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.02.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

The most important factor in the current market is not the present price level of materials but their availability six weeks from now.

Every effort is being made by manufacturers and dealers to induce buyers to enter the market at an early date, in order to avoid rush of production, transportation congestion and abrupt price advances when the spring building rush begins.

Materials prices are developing firmness in all directions; non-ferrous metals, in particular, having shown marked upward tendencies during the last week. The iron, steel and lumber industries reflect increasing demand.

The unfilled orders on books of the U. S. Steel Corporation gained 8 per cent in one month and freight loadings have touched a new high record for this season of the year. All these factors point to increased business activity. Bookings of commercial steel castings also increased to the extent of nearly 20 per cent; much of this gain being for railway specialties. Despite this fact, however, shipments of locomotives and bookings of orders have declined gradually since December, 1923.

No price declines were quoted this week in the nine cities reporting regularly to *Engineering News-Record* Price advances and considerable firmness, however, developed in pine and fir, c.-i. pipe and linseed oil.